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(54) **Title**: COMPOSITIONS CONTAINING POLYCARBODIIMIDES AND AMINO COMPOUNDS FOR TREATING KERATINOUS SUBSTRATES

(57) **Abstract**: Compositions including polycarbodiimide and derivatives thereof together with one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof and derivatives thereof to enhance the quality of the keratinous substrates. The present invention relates to a cosmetic treatment and process for treating keratinous materials, in particular for hair-care and hair-styling, wherein the composition can include the polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof in amounts sufficient to impart hydrophobicity to keratinous substrates, including hair fibers, upon application thereto. It is in particular a hair treatment composition and process for one or more of enhancing durable non-permanent shaping and curling of the hair, improving color deposit, improving color retention and extending color durability.



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COMPOSITIONS CONTAINING POLYCARBODIIMIDES AND AMINO COMPOUNDS FOR TREATING KERATINOUS SUBSTRATES

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This patent application claims the benefit of U.S. Non-Provisional Patent Application Serial Nos 15/395,453 filed on December 30, 2016, and entitled "COMPOSITIONS CONTAINING POLYCARBODIIMIDES AND AMINO COMPOUNDS FOR TREATING KERATINOUS SUBSTRATES", 15/395,484 filed on December 30, 2016, and entitled "COMPOSITIONS CONTAINING POLYCARBODIIMIDES AND AMINO COMPOUNDS FOR ENHANCED COLOR RETENTION AND DURABILITY", 14/986,283 filed on December 31, 2015, and entitled "COMPOSITIONS CONTAINING POLYCARBODIIMIDES AND AMINO COMPOUNDS FOR TREATING KERATINOUS SUBSTRATES," and 14/986,114 filed on December 31, 2015, and entitled "COMPOSITIONS CONTAINING POLYCARBODIIMIDES AND AMINO SILICONE COMPOUNDS FOR TREATING KERATINOUS SUBSTRATES," the disclosures of which are incorporated by reference as if fully rewritten herein.

FIELD OF THE INVENTION

[0002] The present invention generally relates to a composition and method for treating keratinous substrates. More particularly, the present invention relates to keratinous treatment compositions having a polycarbodiimide compound, and, in certain embodiments, one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, the combination for durable non-permanent shaping or for durable retention of a non-permanent shape of at least one keratinous fiber and providing protection from extrinsic damage or repair of keratinous fibers.

[0003] In some embodiments, the present invention further generally relates to a composition and method for treating keratinous substrates. More particularly, the present invention relates to keratinous treatment compositions comprising at least one polycarbodiimide compound, and an amino compound chosen from polyamines and comprising at least one polyvinylamine compound, for enhanced style performance.

[0004] In some embodiments, the present invention further generally relates to compositions and methods for treating keratinous substrates. More particularly, the present invention relates to keratinous treatment compositions comprising at least one polycarbodiimide compound, optionally, a colorant or dye, and an amino compound chosen from polyamines and silicone amines, for one or more of enhanced color deposit, color retention, and color fade resistance to shampoo, washing, and to other hair treatments.

BACKGROUND OF THE INVENTION

[0005] The appearance and/or condition of keratinous substrates, for example, keratinous fibers such as hair, skin, nails, and lips, are often affected by both extrinsic and intrinsic factors such as aging. In particular, when keratinous substrates are exposed to environmental conditions, for example, high or low humidity or to ultraviolet radiation from the sun, these substrates can lose many of their desirable properties and even become damaged. Keratinous fibers, especially hair, are constantly exposed to harsh extrinsic conditions, such as sun, chemical damage, e.g., from detergents, bleaching, relaxing, dyeing, and permanent waving, heat, e.g., from hair dryers or curlers, and mechanical stress or wear, e.g., from brushing or grooming activities. In addition, any type of hair can diminish in quality and/or quantity over time by age and/or due to factors such as natural greasiness, sweat, shedded skin cells from the scalp, pollution, dirt, and extreme humidity conditions.

[0006] The above-described factors can result in thinning hair and/or harm the visual appearance and the feel of the hair, and lead to lank body and decreased volume. For example, hair can dry out and lose its shine or color or become frizzy and less manageable under low and high humidity conditions. Under low humidity conditions, hair can dry out and dried-out hair tends to be less shiny and more brittle. Conversely, under high humidity conditions, hair tends to absorb water, causing hair to lose its shape and become unmanageable and unattractive. Furthermore, hair can lose its desirable attributes due to physical stress on the hair such as brushing and application of heat. The magnitude of the consequences of these factors is variable, depending on, for example, the quality of the hair, length, style, and environmental factors. As such, these factors generally result in damage to the keratinous fibers,

either by affecting protective materials on the surface of the hair (the cuticle), or by altering the hair fiber internally (the cortex).

[0007] More specifically, extrinsic conditions may strip protective materials from the surface of the hair, and/or they may disrupt the organized structure of the hair fibers, called the α -structure, which may be accompanied by a decrease in the tensile strength. Such damage to hair by extrinsic factors is more evident the further the hair fiber has grown from the root, because the hair has been exposed longer to such extrinsic factors. In effect, the hair has what may be called a "damage history" as it grows, i.e., the further from the root, the lower the tensile strength and the greater the breakdown in α -structure that has occurred. As a result, consumers continue to seek products such as hair care and hair cosmetic compositions which protect and enhance the appearance of hair as well as reduce the deleterious effects of adverse environmental conditions, photo-damage, and physical stress.

[0008] Morphologically, a hair fiber contains four structural units: cuticle, cortex, medulla, and intercellular cement. Robbins, C. R. Chemical and Physical Behavior of Human Hair, 3rd Edition, Springer-Verlag (1994). The cuticle layers are located on the hair surface and consist of flat overlapping cells ("scales"). These scales are attached at the root end and point toward the distal (tip) end of the fiber and form layers around the hair cortex. The cortex comprises the major part of the hair fiber. The cortex consists of spindle-shaped cells, or macrofibrils, that are aligned along the fiber axis. The macrofibrils further consist of microfibrils (highly organized protein units) that are embedded in the matrix of amorphous protein structure. The medulla is a porous region in the center of the fiber. The medulla is a common part of wool fibers but is found only in thicker human hair fibers. Finally, the intercellular cement is the material that binds the cells together, forming the major pathway for diffusion into the fibers.

[0009] The mechanical properties of hair are determined by the cortex. A two-phase model for the cortex organization has been suggested. Milczarek et al, Colloid Polym. Sci., 270, 1106-1115 (1992). In this model, water-impenetrable microfilaments ("rods") are oriented parallel with the fiber axis. The microfilaments are embedded in a water-penetrable matrix ("cement"). Within the microfilaments, coiled protein molecules are arranged in a specific and highly organized way, representing a degree of crystallinity in the hair fiber.

[0010] Similar to other crystalline structures, hair fibers display a distinct diffraction pattern when examined by wide-angle X-ray diffraction. In normal, non-stretched hair fibers this pattern is called an "alpha-pattern". The alpha-pattern or α -structure of hair is characterized by specific repeated spacings (9.8 Å, 5.1 Å, and 1.5 Å). All proteins that display this X-ray diffraction pattern are called α -proteins and include, among others, human hair and nails, wool, and porcupine quill. When the hair fiber is stretched in water, a new X-ray diffraction pattern emerges that is called a " β -pattern", with new spacings (9.8 Å, 4.65 Å, and 3.3 Å).

[0011] Damage to hair may occur in the cuticle and/or the cortex. When normal hair is damaged by heat, chemical treatment, UV radiation, and/or physical/mechanical means, myriad chemical and physical changes are induced in the hair. For example, these damaging processes have been known to produce removal or damage to cuticle scales or to cleave the thioester linkage holding the hydrophobic 18-methyl eicosanoic acid ("18-MEA") layer to hair. Thus, it is commonly observed that undamaged hair exhibits significant hydrophobic character, whereas damaged hair shows significant hydrophilic character due to the removal of surface lipids.

[0012] There is a need, therefore, for cosmetic products that are useful in protecting the chemical and physical structure of keratinous fibers from harsh extrinsic conditions and restoring the hair's physical properties to undamaged states following damage by extrinsic conditions. More particularly, there is a need to find materials or compositions or methods that can provide a water-resistant and/or hydrophobic and/or protective barrier to hair to protect it at the cortex. Such a protective barrier should not be easily transferred from the substrate over time by normal everyday activity. In addition, the protective barrier should be shampoo, wash or water-resistant so that the barrier is not easily removed. Non-transfer and shampoo, wash or water-resistant cosmetic, hair and skin care compositions are sought which have the advantage of forming a deposit which does not undergo even partial transfer to the substrates with which they are brought into contact (for example, clothing). It is also desirable to have compositions that do not easily "run off" or wash off the skin and lips when exposed to water, rain or tears. Accordingly, a product that provides a protective barrier to the substrate that also is shampoo, wash or water resistant and non-transferable would be of benefit to the area of cosmetic

products. As such, makers of cosmetic products such as hair and skin care products continue to seek materials and ingredients that can provide such benefits.

[0013] In addition, in today's market, many consumers prefer the flexibility of non-permanent hairstyles, that is, those styles obtained via non-permanent shaping of the hair. Typically, such non-permanent styles disappear when the hair is wetted, especially when the hair is washed with water and/or shampoo or when the hair is exposed to high humidity conditions. Methods for non-permanent shaping of keratinous fibers include, for example, brushing, teasing, braiding, the use of hair rollers, and heat styling, optionally with a commercially available styling product. Non-limiting examples of heat styling include blow drying, crimping, curling, and straightening methods using elevated temperatures (such as, for example, setting hair in curlers and heating, and curling with a curling iron and/or hot/steam rollers and/or flat iron).

[0014] While such compositions and methods may provide for non-permanent shaping of keratinous fibers, many consumers also desire longer lasting or durable styling/shaping than most known materials (e.g., film-forming agents, resins, gums, and/or adhesive polymers), commercially available products (e.g., conventional hair sprays, mousses, gels and lotions), and methods employing these materials and products provide. For example, many consumers desire compositions and methods that improve and preserve non-permanent curl formation or hair style.

[0015] Further, many people desire compositions and methods for retaining a particular non-permanent shape or style of keratinous fibers such as hair. A common way to retain a particular hairstyle is with the use of a hairspray, typically applied after styling the hair. Other methods to retain a hairstyle or shape of keratinous fibers include the use of mousses, gels, and lotions. The materials in these compositions are generally film forming agents, resins, gums, and/or adhesive polymers.

[0016] There is a need, therefore, for materials, compositions and methods that result in more durable or longer lasting shape or style even when the styled/shaped/curled hair is exposed to adverse environmental and physical factors and/or when wetted, washed, or shampooed.

[0017] To achieve at least one of these and other advantages, the present invention provides a method of protecting and/or repairing a keratinous substrate,

and more particularly, a keratinous fiber chosen from hair, eyelashes and eyebrows from extrinsic damage caused by heating, UV radiation or chemical treatment by applying to said keratinous fiber a composition that includes a polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, the combination in an amount effective to confer or improve the keratinous fiber's hydrophobicity.

[0018] Further, the process of changing the color of hair can involve either depositing an artificial color onto the hair, which provides a different shade or color to the hair, or lifting the color of the hair, such as for example, from a dark brown shade to a medium brown or a light brown shade. Hair color can be changed using permanent, semi-permanent, or temporary hair coloring products.

[0019] Many consumers desire a permanent color change or long lasting color and therefore use products containing permanent dyes. Conventional permanent hair coloring products are dye compositions comprising oxidation dye precursors, which are also known as primary intermediates or couplers. These oxidation dye precursors are colorless or weakly colored compounds which, when combined with oxidizing products, give rise to colored complexes by a process of oxidative condensation. The oxidizing products conventionally use peroxides such as hydrogen peroxide as oxidizing agents. Such permanent hair color products also contain ammonia or other alkalizing agents such as monoethanolamine (MEA) which causes the hair shaft to swell, thus allowing the small oxidative dye molecules to penetrate the cuticle and cortex before the oxidation condensation process is completed. The resulting larger-sized colored complexes from the oxidative reaction are then trapped inside the hair fiber, thereby permanently altering the color of the hair.

[0020] Newly, permanently colored hair usually has a vibrant, shiny, and rich appearance. Unfortunately, however, in just a few short weeks, or in some cases even less time, the color begins to fade due to washing or exposure to environmental conditions. For instance, gorgeous rich brown colors become muddy and dull, beautiful shades of blonde turn brassy, and vibrant reds do not look so vibrant anymore acquiring golden, orange or brownish tonalities not desirable to the consumer. As described herein, the inventors of the instant disclosure have

developed compositions and methods that confer one or more benefits including improved color deposit, improved color retention and extended color durability.

BRIEF SUMMARY OF THE INVENTION

[0021] In an exemplary embodiment, a keratinous treatment composition including a polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof is disclosed. The composition includes from about 0.25 to about 10.0% by weight, based on the total weight of the composition, of a combined amount of the polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof. The composition includes amounts of each of the polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof sufficient to impart one or more of hydrophobicity or increased hydrophobicity to the keratinous substrate after application thereto and increased hold to the shape or configuration of the keratinous substrate.

[0022] In another exemplary embodiment, a method of protecting a keratinous substrate chosen from hair, eyelashes and eyebrows from extrinsic damage caused by heating, UV radiation or chemical treatment, or of repairing a keratinous substrate chosen from hair, eyelashes and eyebrows following extrinsic damage caused by heating, UV radiation or chemical treatment. The method includes applying to the keratinous substrate a composition including the polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof in an amount effective to protect or repair the keratinous substrate; wherein the polycarbodiimide compound is present at a concentration of from about 0.1 to about 8% by weight, based on the total weight of the composition.

[0023] Another embodiment of the present invention is method protecting a keratinous substrate chosen from hair comprising applying to the keratinous fiber the composition of the present invention in an amount effective to protect or repair said keratinous substrate before or during or after chemically treating the hair (e.g.,

dyeing the hair using permanent, semi-permanent or demi-permanent dyeing compositions, bleaching/lightening or lifting the color of hair by chemical oxidizing agents, perming the hair using chemical reducing/oxidizing agents, relaxing the hair using lye and no-lye compositions, straightening the hair using chemical straightening agents).

[0024] In some embodiments, the keratinous substrate in the above described composition is heated and the composition is applied to the substrate prior to heating or during heating or after heating the substrate.

[0025] In another exemplary embodiment, a method for durable non-permanent shaping of at least one keratinous substrate or for durable retention of a non-permanent shape of at least one keratinous substrate is disclosed. The method includes applying to said at least one keratinous substrate the composition including the polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof.

[0026] In some embodiments, the above-described method includes a step of heating the keratinous substrate prior to or during or after the application of the above-described composition.

[0027] The present invention is also directed to a method for cosmetic treatment of keratinous tissues, such as keratinous fibers, by applying the above-disclosed composition onto a surface of the keratinous tissue, such as the cuticle of hair fibers.

[0028] The present invention is also directed to methods and kits for cosmetic treatment of keratinous tissues, such as keratinous fibers, by applying the above-disclosed composition onto a surface of the keratinous tissue, such as the cuticle of hair fibers in a step wise fashion. According to some such embodiments, the kit includes separate packaging of one or more of the actives of the inventive composition provided in one or more of thickened or un-thickened aqueous and non-aqueous phases, and packaging of any of the foregoing with one or more of processing agents selected from a coloring agent, a pigmenting agent, a permanent process agent, a relaxing process agent, a straightening process agent, and a highlighting process agent.

[0029] In yet another exemplary embodiment, a keratinous treatment composition including a polycarbodiimide compound and an amino compound chosen from polyvinylamines is disclosed. The composition includes about 0.1% to about 40.0%, by weight, based on the total weight of the composition, of a combined amount of the polycarbodiimide compound and the amino compound chosen from polyvinylamines. The composition includes amounts of each of the polycarbodiimide compound and the amino compound chosen from polyvinylamines sufficient to impart one or more of lasting style-humidity resistance and increased styling hold without compromising cosmeticity, with and without the use of heat after application.

[0030] In some embodiments, the composition comprises about 0.25% to about 20%, by weight, based on the total weight of the composition, of a combined amount of the polycarbodiimide compound and the amino compound chosen from polyvinylamines, and in some embodiments, from about 1% to about 10%, and in some other embodiments, from about 1% to about 5%, by weight, based on the total weight of the composition.

[0031] In some embodiments, the composition comprises at least one polycarbodiimide compound and at least one polyvinylamine compound, wherein the ratio of the polycarbodiimide to polyvinylamine in the composition is in the range from 10:1 to 1:10.

[0032] In some embodiments, the composition comprises at least one or more of each of the components including a polyvinylamine compound, a polycarbodiimide compound, a cationic surfactant, a non-ionic surfactant, an aminosilicone, a non-ionic film former, a polyol, a propellant, and water.

[0033] In another exemplary embodiment, a method of protecting a keratinous substrate chosen from hair, eyelashes and eyebrows from extrinsic damage caused by heating, UV radiation or chemical treatment, or of repairing a keratinous substrate chosen from hair, eyelashes and eyebrows following extrinsic damage caused by heating, UV radiation or chemical treatment. The method includes applying to the keratinous substrate a composition including the polycarbodiimide and the amino compound chosen from polyvinylamines in an amount effective to protect or repair the keratinous substrate; wherein the polycarbodiimide compound is present at a

concentration of from about 0.01% to about 20% by weight, based on the total weight of the composition.

[0034] In yet another exemplary embodiment, a keratinous treatment composition including a polycarbodiimide compound, optionally a colorant or dye, and an amino compound chosen from polyamines and silicone amines is disclosed. The composition includes about 0.1% to about 40.0%, by weight, based on the total weight of the composition, of a combined amount of the polycarbodiimide compound and the amino compound. The composition includes amounts of each of the polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines sufficient to impart one or more of improved color deposit, improved color retention and extended color durability.

[0035] In some embodiments, the composition comprises a combined amount of the polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines from about 0.25 to about 20%, by weight, based on the total weight of the composition, and in some embodiments, from about 1% to about 10%, and in some embodiments, from about 1% to about 5%, by weight, based on the total weight of the composition.

[0036] In another exemplary embodiment, a method of treating a keratinous substrate chosen from hair, eyelashes and eyebrows includes applying to the keratinous substrate a composition including the polycarbodiimide and the amino compound chosen from polyamines and silicone amines in an amount effective to impart one more of improved color deposit, improved color retention and extended color durability; wherein the polycarbodiimide compound is present at a concentration of from about 0.01 to about 20% by weight, based on the total weight of the composition.

[0037] In some particular embodiments, the composition comprises a dye or colorant together with a combined amount of the polycarbodiimide compound and the amino compound chosen from polyamines from about 0.1% to about 40%, by weight, based on the total weight of the composition, and in some embodiments, from about 0.25 to about 20%, and in some embodiments from about 1% to about 10%, and in some embodiments, from about 1% to about 5%, by weight, based on

the total weight of the composition. According to such embodiments, the polyamine may be chosen from polyvinylamines.

[0038] In some particular embodiments, the composition comprises a combined amount of the polycarbodiimide compound and the amino compound chosen from silicone amines from about 0.1% to about 40%, by weight, based on the total weight of the composition, and in some embodiments, from about 0.25 to about 20%, and in some embodiments from about 1% to about 10%, and in some embodiments, from about 1% to about 5%, by weight, based on the total weight of the composition. According to such embodiments, the silicone amine may be chosen from side chain silicones. In a particular embodiment, the silicone amine may be amodimethicone.

[0039] The present invention is also directed to a method for cosmetic treatment of keratinous tissues, such as keratinous fibers, by applying to a surface of the keratinous tissue, such as the cuticle of hair fibers a composition comprising polycarbodiimide compound, optionally a colorant or dye, and an amino compound chosen from polyamines and silicone amines.

[0040] In some embodiments, the composition is applied together with color treatment. In some such embodiments, the composition comprises a colorant or dye, and an amino compound chosen from polyamines.

[0041] In some embodiments, the composition is applied at a time following color treatment. In some such embodiments, the composition comprises an amino compound chosen from silicone amines.

[0042] In some embodiments, the composition is applied at a time preceding color treatment.

[0043] In some embodiments, the keratinous substrate in the above-described composition is heated and the composition is applied to the substrate before heating or during heating or after heating the substrate.

[0044] Other features and advantages of the present invention will be apparent from the following more detailed description of the preferred embodiment which illustrates, by way of example, the principles of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0045] Other than in the operating examples, or where otherwise indicated, all numbers expressing quantities of ingredients and/or reaction conditions are to be understood as being modified in all instances by the term "about," meaning within 10% of the indicated number (e.g. "about 10%" means 9% – 11% and "about 2%" means 1.8% - 2.2%).

[0046] The articles "a" and "an," as used herein, mean one or more when applied to any feature in embodiments of the present invention described in the specification and claims. The use of "a" and "an" does not limit the meaning to a single feature unless such a limit is specifically stated. The article "the" preceding singular or plural nouns or noun phrases denotes a particular specified feature or particular specified features and may have a singular or plural connotation depending upon the context in which it is used. The adjective "any" means one, some, or all indiscriminately of whatever quantity.

[0047] "Active material" or "weight" as used herein with respect to the percent amount of an ingredient or raw material, refers to 100% activity of the ingredient or raw material. All percentages and ratios are calculated by weight unless otherwise indicated. All percentages are calculated based on the total composition unless otherwise indicated. Generally, unless otherwise expressly stated herein, "weight" or "amount" as used herein with respect to the percent amount of an ingredient refers to the amount of the raw material comprising the ingredient, wherein the raw material may be described herein to comprise less than and up to 100% activity of the ingredient. Therefore, weight percent of an active in a composition is represented as the amount of raw material containing the active that is used, and may or may not reflect the final percentage of the active, wherein the final percentage of the active is dependent on the weight percent of active in the raw material.

[0048] The term "altering the color" and variations thereof as used herein may refer to dyeing or coloring hair or depositing color onto the hair.

[0049] As used herein, the terms "applying a composition onto keratin fibers" and "applying a composition onto hair" and variations of these phrases are intended to mean contacting the fibers or hair, with at least one of the compositions of the invention, in any manner.

[0050] “At least one,” as used herein, means one or more and thus includes individual components as well as mixtures/combinations.

[0051] “Color deposit” refers to refers to a visually distinguishable color effect imparted to a keratinous substrate by the application of a composition including a colorant or dye to the substrate, resulting in permanent, ie, not “wash out” or “try on” color application or composition.

[0052] “Color retention” and “extended color durability” refer to the maintenance of visibly distinguishable color effect imparted to a keratinous substrate from an application of a composition including a colorant or dye to the substrate, and in particular, increased maintenance of the color effect using compositions according to the disclosure as compared with comparative compositions that lack the inventive combinations of polycarbodiimide and one or more of amino compounds selected from polyamines and silicone amines.

[0053] The term “comprising” (and its grammatical variations) as used herein is used in the inclusive sense of “having” or “including” and not in the exclusive sense of “consisting only of.”

[0054] “Conditioning,” as used herein, means imparting at least one of combability, manageability, moisture-retentivity, luster, shine, softness, and body to the hair.

[0055] “Durable conditioning,” as used herein, means that, following at least one shampoo/washing/rinsing after treatment of keratinous fibers such as hair with the compositions of the present disclosure, treated hair still remains in a more conditioned state as compared to untreated hair. The state of conditioning can be evaluated by measuring, and comparing, the ease of combability of the treated hair and of the untreated hair in terms of combing work (gm-in) and/or the substantivity of the conditioning agent on the hair and/or the hydrophobicity of hair which can be assessed by contact angle measurements (spread of a water droplet on the surface of the hair).

[0056] “Durable retention of a shape,” as used herein, means that, following at least one shampoo/washing/rinsing or exposure to high humidity conditions after treatment of keratinous fibers such as hair with the compositions of the present disclosure, treated hair still exhibits the ability to retain a particular or desirable

shape after styling as compared to the exhibited ability of untreated hair to retain a particular or desirable shape after styling. "Durable retention of a shape" can also be related to the hydrophobicity of hair which can be assessed by contact angle measurements (spread of a water droplet on the surface of the hair).

[0057] "Durable shaping," as used herein, refers to holding or keeping a shape of a keratinous fiber until the keratinous fiber is washed with water and/or shampoo or exposed to high humidity conditions. Retention of a shape can be evaluated by measuring, and comparing, the ability to retain a curl under conditions of high relative humidity of the treated hair and of the untreated hair in terms of Curl Efficiency. "Durable shaping" can also be related to imparting hydrophobicity to hair which can be assessed by contact angle measurements (spread of a water droplet on the surface of the hair).

[0058] "Heating" refers to the use of elevated temperature (i.e., above room temperature such as at or above 40° C). In one embodiment, the heating in the inventive method may be provided by directly contacting the at least one keratinous fiber with a heat source, e.g., by heat styling of the at least one keratinous fiber. Non-limiting examples of heat styling by direct contact with the at least one keratinous fiber include flat ironing and curling methods using elevated temperatures (such as, for example, setting hair in curlers and heating, and curling with a curling iron and/or hot rollers). In another embodiment, the heating in the inventive method may be provided by heating the at least one keratinous fiber with a heat source which may not directly contact the at least one keratinous fiber. Non-limiting examples of heat sources which may not directly contact the at least one keratinous fiber include blow dryers, hood dryers, heating caps and steamers.

[0059] "A heat-activated" composition, as used herein, refers to a composition which, for example, shapes the at least one keratinous fiber better than the same composition which is not heated during or after application of the composition. Another example includes a composition that retains a shape of at least one keratinous fiber better than the same composition that is not heated during or after application.

[0060] "High humidity," as defined herein, refers to atmospheric humidity above 40%.

[0061] "Homogeneous" means having the visual appearance of being substantially uniform throughout, i.e., visually appears as a single-phase emulsion and/or dispersion.

[0062] "Keratinous substrate," as used herein, includes, but is not limited to, skin, hair, and nails. "Keratinous substrate" as used herein also includes "keratinous tissue" or "keratinous fibers," which as defined herein, may be human keratinous fibers, and may be chosen from, for example, hair, such as hair on the human head, or hair comprising of eyelashes or hair on the body.

[0063] The term "style" or styling" as used herein includes shaping, straightening, curling, or placing a keratin fiber such as hair, in a particular arrangement, form or configuration; or altering the curvature of a keratinous fiber or other substrate; or re-positioning a keratin fiber or other substrate to a different arrangement, form or configuration; or providing/maintaining a hold to the shape or configuration of the keratin fiber. In some embodiments, the hold to the shape or configuration of the fiber may be expressed as an improved bending force property, and may be assessed using a common three point bending test.

[0064] As used herein, the terms "styling keratinous fibers" and variations thereof are understood to refer to any means or method of modifying the appearance of the keratinous fibers or the hair with respect to their spatial arrangement or configuration or curvature or form. When the keratinous fibers comprise hair on the human head, the term "styling keratinous fibers" or "styling hair" is also understood to include curling or waving or embossing the hair or smoothing or straightening the hair, or spiking the hair or providing/maintaining a hold to the shape or configuration of the keratin fiber.

[0065] The term "treat" (and its grammatical variations) as used herein refers to the application of the compositions of the present invention onto keratinous substrates such as keratinous fibers or hair or skin.

[0066] The term "wash cycle" as used herein, refers to a step or process of washing a keratinous substrate and may include treating the substrate with a surfactant-based product (e.g., shampoo or conditioner or body wash) then washing or rinsing the substrate with water. The term "wash cycle" may also include washing or rinsing the substrate with water.

[0067] Referred to herein are trade names for materials including, but not limited to polymers and optional components. The inventors herein do not intend to be limited by materials described and referenced by a certain trade name. Equivalent materials (e.g., those obtained from a different source under a different name or catalog (reference number) to those referenced by trade name may be substituted and utilized in the methods described and claimed herein.

[0068] All percentages and ratios are calculated by weight unless otherwise indicated. All percentages are calculated based on the total weight of a composition unless otherwise indicated. All component or composition levels are in reference to the active level of that component or composition, and are exclusive of impurities, for example, residual solvents or by-products, which may be present in commercially available sources.

[0069] It is an object of the present invention to provide materials and compositions and methods which provide both a protective barrier onto keratinous substrates such as hair which impart native/undamaged physical properties—such as hydrophobicity, ease of combing, etc.—to hair, in particular, damaged hair, as well as impart durable or long lasting physical properties mimicking natural/undamaged hair to treated hair. It is also an object of the present invention to provide materials and compositions and methods which improve the resistance of the keratinous substrate to humidity and other environmental conditions so as to preserve the retention of durable non-permanent shaping or for durable retention of a non-permanent shape of at least one keratinous fiber.

[0070] It has been surprisingly and unexpectedly discovered by the inventors that a composition containing the combination of one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, and polycarbodiimides for cosmetic application, when applied to keratinous substrates such as hair, enhance the properties (hydrophobicity, adhesion, chemical resistance, water resistance etc.) and deliver superior performance to the substrate. In embodiments of this disclosure, the combination of polycarbodiimide compounds with one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof enhance the properties of hair wherein the combination increases the conditioning effect (e.g., hydrophobicity,

shine and smoothness), strengthens the hair, increases the stiffness and humidity resistance of hair and ameliorates the condition of damaged hair by improving the appearance and quality of hair (for example, smoother feel, softer feel, less frizzy, less dry, more discipline). In addition, the composition, according to the present disclosure, provides a significant reduction in combing force which indicates that hair is easier to comb and/or has less tangling.

[0071] The compositions according to the present disclosure imparted increased percent curl retention on curled/shaped hair indicating higher resistance of the hair to high humidity and high temperature as compared to compositions with either material alone.

[0072] It was also surprisingly and unexpectedly discovered by the inventors that curled/shaped hair treated with the compositions according to the present disclosure maintained its shape (i.e., same or similar degree of curl retention) even after shampooing/washing the hair.

[0073] It is also an object of the present invention to provide materials and compositions and methods which provide both a robust film onto keratinous substrates such as hair which impart native/undamaged physical properties—such durable or long lasting physical properties mimicking natural/undamaged hair to treated hair. It is also an object of the present invention to provide materials and compositions and methods which improve the resistance of the keratinous substrate to humidity and other environmental conditions as well as to cleansing/washing so as to preserve the retention of durable non-permanent shaping or for durable retention of a non-permanent shape of at least one keratinous fiber. Furthermore, it is an object of the present invention to provide materials and compositions and methods that provide a protective barrier or coating onto keratinous substrates, e.g. hair, that enhances or imparts hydrophobicity, ease of combing, *etc.*—to hair, in particular, damaged hair, as well as impart a hold to the shape or configuration of the hair.

[0074] It has been surprisingly discovered by the inventors that compositions comprising a combination at least one polycarbodiimide compound and at least one amino compound chosen from polyvinylamines, when applied to keratinous substrates such as hair, with and without heat, improves lasting style-humidity

resistance, and imparts increased styling hold. The surprising results are seen in compositions wherein polycarbodiimide is added to cosmetic compositions comprising a polyvinylamine, wherein the combination is at a ratio in the range from about 1:1 to about 1:2 of polycarbodiimide to polyvinylamine-containing composition, and wherein styling performance is increased without compromising conditioning benefits, long lastingness of the hair style is imparted, and lasting humidity resistance and styling hold are increased significantly without compromising the cosmeticity.

[0075] Thus, in some embodiments according to this disclosure, curled/shaped hair treated with the combination of polycarbodiimide with polyvinylamines compounds maintained its shape (i.e., exhibited an enhanced degree of curl retention for the association than observed with either compound alone) as demonstrated in High Humidity Curl Retention and Three Point Bending tests, demonstrating improved styling performance of the compositions as compared to compositions comprising only one or the other of polycarbodiimide and polyvinylamine.

[0076] It has also been surprisingly and unexpectedly discovered by the inventors that compositions comprising a combination at least one polycarbodiimide compound and at least one amino compound chosen from polyamines and silicone amines, particularly compositions wherein the amino compound is selected from silicone amines, when applied in combination with a colorant or dye compound to keratinous substrates such as hair, with and without heat, deposit color more effectively as compared to traditional or commercial hair dyes using similar or less amounts of dye compounds. It has also been surprisingly and unexpectedly discovered by the inventors that compositions as described, particularly compositions wherein the amino compound is selected from polyamines, when applied prior to application of color, provide for lasting retention of color in treated hair, even after repeated washings and other post color treatments. Thus, the compositions and methods of the present invention can provide for enhanced color visibility and coverage and color retention and durability.

[0077] Without being bound to any one theory, the inventors of the present disclosure believe that the keratinous treatment compositions of the invention react to each other and to the keratin substrate when such compositions are applied onto

keratinous substrates such as hair or skin to form a crosslinked network of polymers. It is further believed that the crosslinked compositions provide a protective barrier useful in cosmetic applications, in particular but not limited to hair care, such that the hydrophobicity of the keratinous substrates is improved or restored resulting in the observed performance as reported herein, and significantly better cosmetic styling effects, feel and appearance, and less damaged condition of the substrates such as hair and skin. It is further believed that the crosslinked compositions provide a protective barrier useful in cosmetic applications, in particular but not limited to hair cosmetics, such that the hydrophobicity of the keratinous substrates is improved or restored resulting in the observed performance as reported herein, and one or more of significantly improved color deposit, improved color retention and extended color durability.

[0078] In some embodiments, compositions according to the invention, are compositions including polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof. The composition may include other suitable ingredients for hair treatment or hair repair. For example, known solvents and/or additives may be utilized in addition to the polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof to provide additional benefits to the composition. When both polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof are utilized in combination to form the inventive composition, a significant increase in hydrophobicity of keratinous fiber is provided.

[0079] In some other embodiments, compositions, according to the invention, are compositions including at least one or more of polycarbodiimide and amino compounds chosen from polyvinylamines. The composition may include other suitable ingredients for hair treatment or hair repair. For example, known solvents and/or additives may be utilized in addition to the polycarbodiimide compound and amino compound chosen from polyvinylamines to provide additional benefits to the composition.

[0080] In yet other embodiments, the compositions, according to the invention, are compositions including at least one or more of each of polycarbodiimide and amino compounds, and optionally one or more dyes or colorants. The composition may include other suitable ingredients for hair treatment or hair repair. For example, known solvents and/or additives may be utilized in addition to the polycarbodiimide compound and amino compound chosen from polyamines and silicone amines to provide additional benefits to the composition.

[0081] In some embodiments, the range of concentrations by weight of the composition over which the association provides hydrophobicity to and/or hold to the shape or configuration of keratinous substrates is from about 0.01% to about 10%, such as from about 0.5% to about 8%, or such as from about 1% to about 5% of combined amount of the polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof. The range of the weight ratio of the polycarbodiimide to one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof in the composition over which their association provides hydrophobicity to keratinous substrates such as hair, is from about 20:1 to about 20:1, or such as from about 10:1 to about 1:10 or such as from about 20:1 to about 1:1, including all ranges and subranges there-between. In certain embodiments, the weight ratio of polycarbodiimide to one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof in the compositions of the present disclosure at which hydrophobicity is imparted to keratinous substrates is at about 1:1 or about 1:2 or about 1:3 or about 1:4 or about 1:5 or about 1:7 or about 1:7 or about 1:8 or about 1:9 or about 1:10 or about 10:1 or about 9:1 or about 8:1 or about 7:1 or about 8:1 or about 7:1 or about 6:1 or about 5:1 or about 4:1 or about 3:1 or about 2:1.

[0082] Compositions comprising one or more of each of Polycarbodiimide and Polyvinylamine Compounds

[0083] In accordance with the various embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines is present in the compositions according to the disclosure in amounts range from

about 0.1% to about 40%, and in some embodiments from about 0.25% to about 20%, and in some further embodiments from about 1% to about 10%. In some representative embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines is present from about 0.5% to about 10%, and from about 0.5% to about 5%. In yet other embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines is present from at least 0.5%. And in yet other embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines is present from at least 0.5% to up to about 40%. In some specific embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines is present at about 5%. In some other specific embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines is present at about 2.5%. In some other specific embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines is present at about 0.75%.

[0084] Thus, the combination of polycarbodiimide compound and the amino compound chosen from polyvinylamines may be present from about 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 to about 40 percent by weight, including increments and ranges therein and there between.

[0085] The range of the weight ratio of the polycarbodiimide to the amino compound chosen from polyvinylamines in the composition over which their association provides hydrophobicity to keratinous substrates such as hair, is from about 10:1 to about 1:10, including all ranges and subranges there-between.

[0086] In various embodiments, the combination of the polycarbodiimide compound and the amino compound chosen from polyvinylamines is present in the compositions in the foregoing amounts, wherein the ratio of the polycarbodiimide compound to the amino compound chosen from polyvinylamines ranges from about 10:1 to about 1:10. In some exemplary embodiments, the ratio of the polycarbodiimide compound to the amino compound chosen from polyvinylamines is from about 2:1 to 1:2. In some exemplary embodiments, the ratio of the polycarbodiimide compound to the amino compound chosen from polyvinylamines is

from about 1:1. In some other exemplary embodiments, the ratio of the polycarbodiimide compound to the amino compound chosen from polyvinylamines is from about 1:2.

[0087] In some embodiments, compositions according to the disclosure comprise, in addition to the polycarbodiimide and polyvinylamine compounds, additional optional compounds as more fully described herein. In some particular embodiments, the compositions comprise at least one or more additional compounds selected from polymeric (for example, cellulosic) based thickeners, amphoteric surfactants, nonionic fixing polymers, cationic surfactants, polyols, and propellants.

[0088] Compositions comprising one or more of each of Polycarbodiimide and Amino compounds selected from polyamines and silicone amines

[0089] In accordance with the various embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present in the compositions according to the disclosure in amounts range from about 0.1% to about 40%, and in some embodiments from about 0.01% to about 20%, and in some further embodiments from about 1% to about 10%. In some representative embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present from about 0.5% to about 10%, and from about 0.5% to about 5%. In yet other embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present from at least 0.5%. And in yet other embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present from at least 0.5% to up to about 40%. In some specific embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present at about 5%. In some other specific embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present at about 2.5%. In some other specific embodiments, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present at about 0.75%.

[0090] Thus, the combination of polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines may be present from about 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 to about 40 percent by weight, including increments and ranges therein and there between.

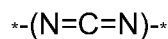
[0091] The range of the weight ratio of the polycarbodiimide to the amino compound chosen from polyamines and silicone amines in the composition over which their association provides hydrophobicity to keratinous substrates such as hair, is from about 10:1 to about 1:10, including all ranges and subranges there-between.

[0092] In various embodiments, the combination of the polycarbodiimide compound and the amino compound chosen from polyamines and silicone amines is present in the compositions in the foregoing amounts, wherein the ratio of the polycarbodiimide compound to the amino compound chosen from polyamines and silicone amines ranges from about 10:1 to about 1:10. In some exemplary embodiments, the ratio of the polycarbodiimide compound to the amino compound chosen from polyamines and silicone amines is from about 2:1 to 1:2. In some exemplary embodiments, the ratio of the polycarbodiimide compound to the amino compound chosen from polyamines and silicone amines is from about 1:1. In some other exemplary embodiments, the ratio of the polycarbodiimide compound to the amino compound chosen from polyamines and silicone amines is from about 1:2.

[0093] In some embodiments, compositions according to the disclosure comprise, in addition to the polycarbodiimide and amino compounds selected from polyamines and silicone amines, additional optional compounds as more fully described herein. In some particular embodiments, the compositions comprise at least one or more additional compounds selected from polymeric (for example, cellulosic) based thickeners, amphoteric surfactants, nonionic fixing polymers, cationic surfactants, polyols, and propellants.

[0094] Polycarbodiimide Compounds

[0095] A carbodiimide group is a linear triatomic moiety generally depicted by Formula (I):

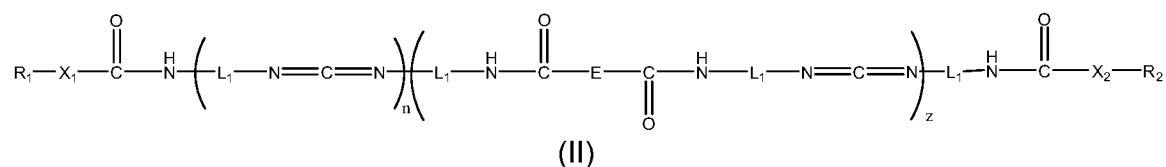


(I)

[0096] At least one of the nitrogens is linked to or incorporated into a backbone or other bridging group to result in a molecule having at least two carbodiimide groups.

[0097] Polycarbodiimides

[0098] In one embodiment, the polycarbodiimides comprising of at least two carbodiimide units, as described above, can be represented by Formula (II):



[0099] wherein X_1 and X_2 each independently represent O, S or NH. R_1 and R_2 are selected from a hydrocarbon group containing one or more catenary or non-catenary hetero-atoms, such as nitrogen, sulfur and oxygen, and linear or branched and cyclic or acyclic groups which can be ionic or non-ionic segments, or a partially or fully fluorinated hydrocarbon group that may contain one or more catenary or non-catenary hetero-atoms; n and z are, each independently, an integer of 0 to 20; L_1 (Linker of carbodiimide groups) is selected from a C_1 to C_{18} divalent aliphatic hydrocarbon group, a C_3 to C_{13} divalent alicyclic hydrocarbon group, a C_6 to C_{14} divalent aromatic hydrocarbon group, and a C_3 to C_{12} divalent heterocyclic group; wherein a plurality of L_1 s may be identical to or different from one another, and wherein in another embodiment, L_1 of formula (II) is selected from a C_1 to C_{18} divalent aliphatic hydrocarbon group, a C_3 to C_{13} divalent alicyclic hydrocarbon group, a C_6 to C_{14} divalent aromatic hydrocarbon group that is not chosen from *m*-tetramethylxylylene, and a C_3 to C_{12} divalent heterocyclic group; wherein a plurality of L_1 s may be identical to or different from one another;

wherein E is a radical selected from the following formulas:

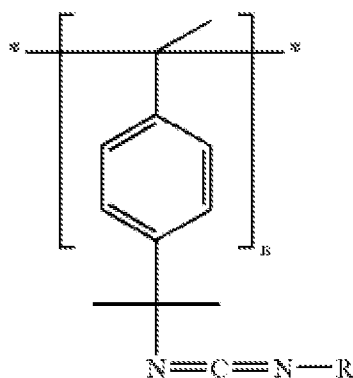


wherein R_3 and R_4 are each independently hydrocarbon radicals that may contain halogen atoms or one or more catenary (i.e.; in chain, bonded only to carbon) or non-catenary hetero atoms, including an aromatic, cycloaliphatic, aryl and alkyl radical (linear or branched) and R_5 is hydrogen, or a hydrocarbon radical which can contain halogen atoms or one or more catenary (i.e.; in chain, bonded only to carbon) or non-catenary hetero atoms.

[00100] Examples of R_1 and R_2 can be methyl glycolate, methyl lactate, polypropylene glycol, polyethylene glycol monomethyl ether, dialkylamino alcohol.

[00101] Examples of L_1 can be the diradical of tolylene, hexamethylene, hydrogenated xylylene, xylylene, 2,2,4-trimethylhexamethylene, 1,12-dodecane, norbornane, 2,4-bis-(8-octyl)-1,3-dioctylcyclobutane, 4,4'-dicyclohexylmethane, tetramethylxylylene, isophorone, 1,5-naphthylene, 4, 4' diphenylmethane, 4, 4' diphenyldimethylmethane, phenylene.

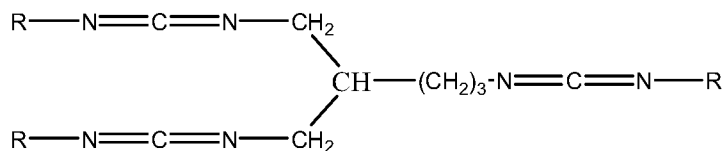
[00102] Polycarbodiimides may include polymers with a plurality of carbodiimide groups appended to the polymer backbone. For example, U.S. Pat. No. 5,352,400 (the disclosure of which is incorporated by reference herein for all purposes as if fully set forth) discloses polymers and co-polymers derived from alpha-methylstyryl-isocyanates. Such a polymer is illustrated in Formula (III).



(III)

wherein R is an alkyl, cycloalkyl or aryl group (in some particular embodiments having from 1 to 24 carbon atoms).

[00103] In another embodiment, polycarbodiimides, according to the present disclosure, include polycarbodiimides having branched structures, like that shown in Formula (IV), and as described in Chapter 8 of Technology for Waterborne Coatings, E. J. Glass Ed., ACS Symposium 663, 1997; The Application of Carbodiimide Chemistry to Coating, by J. W. Taylor and D. R. Bassett (the disclosure of which is incorporated by reference herein for all purposes as if fully set forth).



(IV)

wherein R is an alkyl, cycloalkyl or aryl group (in some particular embodiments having from 1 to 24 carbon atoms).

[00104] In one embodiment, the compositions of the present disclosure does not employ a polycarbodiimide having a linker L₁ chosen from m-tetramethylxylylene.

[00105] Suitable polycarbodiimide compounds include, but are not limited to, those commercially sold by the suppliers Nisshinbo, Picassian, and 3M. Particularly suitable polycarbodiimide compounds include, but are not limited to, those known by the name under the CARBODILITE series, V-02, V02-L2, SV-02, E-02, V-10, SW-12G, E-03A, commercially sold by Nisshinbo.

[00106] In some embodiments, the polycarbodiimide of the present disclosure is selected from compounds of formula (II) wherein L₁ (Linker of carbodiimide groups) represents a C₁ to C₁₈ divalent aliphatic hydrocarbon group, a C₃ to C₁₃ divalent alicyclic hydrocarbon group, a C₃ to C₁₂ divalent heterocyclic group, or a C₆ to C₁₄ divalent aromatic hydrocarbon group;

wherein a plurality of L₁s may be identical to or different from one another.

[00107] In other embodiments, the polycarbodiimide of the present disclosure is selected from compounds of formula (II) wherein L₁ is not chosen from m-tetramethylxylylene.

[00108] In certain embodiments, the composition of the present disclosure is devoid of a polycarbodiimide that has a linker L₁ chosen from m-tetramethylxylylene.

[00109] The polycarbodiimide is typically present in the composition of the present disclosure in an amount of from about 0.01% or from about 0.15% to about 8%, by weight, in certain embodiments from about 0.2% to about 7%, by weight, and in certain embodiments from about 0.25% to about 5%, by weight, including all ranges and subranges therebetween, based on the total weight of the composition.

[00110] In various embodiments, the amount of the polycarbodiimide in the composition of the present disclosure is about 0.01%, 0.05%, 0.25%, 0.5%, 0.55%, 0.9%, 1%, 1.5%, 2%, 2.5%, 3%, 3.5%, 4%, 4.5%, 5%, 5.5%, 6%, 6.5%, 7%, 7.5%, and 8% by weight, based on the total weight of the composition.

[00111] Compositions comprising one or more of each of Polycarbodiimide and Polyvinylamine Compounds

[00112] In accordance with the various embodiments, the polycarbodiimide compound is present in the compositions according to the disclosure in amounts range from about 0.01% to about 20%, and in some embodiments from about 0.1% to about 15%, and in some further embodiments from about 0.1% to about 10%. In some representative embodiments, the polycarbodiimide compound is present from about 0.1% to about 5%, and from about 0.2% to about 3%. In yet other embodiments, the polycarbodiimide compound is present from at least 0.2%. And in yet other embodiments, the polycarbodiimide compound is present from at least 0.2% to up to about 40%. In some specific embodiments, the polycarbodiimide compound is present at about 1.5%. In some specific embodiments, the polycarbodiimide compound is present at about 0.75%. In some other specific embodiments, the polycarbodiimide compound is present at about 0.25%.

[00113] Thus, the polycarbodiimide compound may be present from about 0.01, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, to about 20 percent by weight, including increments and ranges therein and there between.

[00114] Compositions comprising one or more of each of Polycarbodiimide and Amino compounds selected from polyamines and silicone amines

[00115] In accordance with the various embodiments, the polycarbodiimide compound is present in the compositions according to the disclosure in amounts range from about 0.01% to about 20%, and in some embodiments from about 0.1%

to about 15%, and in some further embodiments from about 0.1% to about 10%. In some representative embodiments, the polycarbodiimide compound is present from about 0.1% to about 5%, and from about 0.2% to about 3%. In yet other embodiments, the polycarbodiimide compound is present from at least 0.2%. And in yet other embodiments, the polycarbodiimide compound is present from at least 0.2% to up to about 40%. In some specific embodiments, the polycarbodiimide compound is present at about 1.5%. In some specific embodiments, the polycarbodiimide compound is present at about 0.75%. In some other specific embodiments, the polycarbodiimide compound is present at about 0.25%.

[00116] Thus, the polycarbodiimide compound may be present from about 0.01, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, to about 20 percent by weight, including increments and ranges therein and there between.

[00117] AMINO COMPOUNDS

[00118] AMINES

[00119] In accordance with some embodiments, the compositions according to the present disclosure comprises one or more amino compounds. The term “amino compound” is intended to mean any compound comprising at least one primary, secondary or tertiary amine or a quaternary ammonium group.

[00120] The amino compound of the present disclosure is chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and mixtures thereof. In certain embodiments, the amino compounds of the present disclosure do not contain silicon atoms or silicone moieties. In other embodiments, the amino compounds of the present disclosure contain silicon atoms or silicone moieties.

[00121] Alkyl Monoamines

[00122] The alkyl monoamines of the present disclosure are amino compounds having one amino group.

[00123] Non-limiting examples of preferred alkyl monoamines include aliphatic amine compounds corresponding to formula (IA) and their salts:

[00124] $RN(R')_2$

[00125] (IA)

[00126] wherein:

[00127] R is a hydrocarbon radical containing at least 6 carbon atoms. In addition, R can be linear or branched, acyclic or cyclic, saturated or unsaturated, aliphatic or aromatic, substituted or unsubstituted. Typically, R is a linear or branched, acyclic alkyl or alkenyl group or an alkyl phenyl group; and

[00128] the groups R', which may be identical or different, represent H or a hydrocarbon radical containing less than 6 carbon atoms. In addition, the groups R', which may be identical or different, are linear or branched, acyclic or cyclic, saturated or unsaturated, substituted or unsubstituted. In certain embodiments, the groups R', which may be identical or different, are H or a methyl group.

[00129] Preferred alkyl monoamines include, but are not limited to the following examples: dimethyl lauramine, dimethyl behenamine, dimethyl cocamine, dimethyl myristamine, dimethyl palmitamine, dimethyl stearamine, dimethyl tallowamine, dimethyl soyamine, stearamine, soyamine, cocamine, lauramine, palmitamine, oleamine, tallow amine and mixtures thereof.

[00130] Other non-limiting examples of preferred alkyl monoamines include amidoamine compounds corresponding to formula (IIA) and their salts:

[00131] $RCONHR'N(R'')_2$

[00132] (IIA)

[00133] wherein:

[00134] R is a hydrocarbon radical containing at least 6 carbon atoms. In addition, R can be linear or branched, acyclic or cyclic, saturated or unsaturated, aliphatic or aromatic, substituted or unsubstituted. Typically, R is a linear or branched, acyclic alkyl or alkenyl group or an alkyl phenyl group; and

[00135] R' is a divalent hydrocarbon radical containing less than 6 carbon atoms, in certain embodiments 2 or 3 carbon atoms, and

[00136] R'' is H or a hydrocarbon radical containing less than 6 carbon atoms. In addition, R'' is linear or branched, acyclic or cyclic, saturated or unsaturated, substituted or unsubstituted. Typically, R'' is a linear or branched, acyclic alkyl or alkenyl group. In certain embodiments, R'' is H or a methyl group.

[00137] Preferred amidoamines include, but are not limited to the following examples: oleamidopropyl dimethylamine, stearamidopropyl dimethylamine, isostearamidopropyl dimethylamine, stearamidoethyl dimethylamine, lauramidopropyl dimethylamine, myristamidopropyl dimethylamine, behenamidopropyl dimethylamine, dilinoleamidopropyl dimethylamine, palmitamidopropyl dimethylamine, ricinoleamidopropyl dimethylamine, soyamidopropyl dimethylamine, wheat germamidopropyl dimethylamine, sunflowerseedamidopropyl dimethylamine, almondamidopropyl dimethylamine, avocadoamidopropyl dimethylamine, babassuamidopropyl dimethylamine, cocamidopropyl dimethylamine, minkamidopropyl dimethylamine, oatamidopropyl dimethylamine, sesamidopropyl dimethylamine, tallamidopropyl dimethylamine, brassicaamidopropyl dimethylamine, olivamidopropyl dimethylamine, palmitamidopropyl dimethylamine, stearamidoethyldiethylamine, and mixtures thereof.

[00138] Alkoxylated Polyamines

[00139] The alkoxylated polyamines of the present disclosure are chosen from amine compounds having at least two amino groups and at least one degree of alkoxylation. The alkoxylation is provided by an alkylene oxide group which is in certain embodiments chosen from ethylene oxide and propylene oxide.

[00140] Non-limiting preferred examples of suitable alkoxylated polyamines include compounds corresponding to formula (IB):



[00142] (IB)

[00143] wherein R represents a $-\text{CH}_2-$, $-\text{CH}_2\text{CH}_2-$, $-\text{CHCH}_3-$ or $-\text{C}(\text{CH}_3)_2-$ group, or a hydrocarbon radical containing at least 3 carbon atoms that is linear or

branched, acyclic or cyclic, saturated or unsaturated, aliphatic or aromatic, substituted or unsubstituted;

[00144] x, y, and z independently of one another, represent numbers of from 0 to about 100;

[00145] R' represents hydrogen, or an alkyl group, in certain embodiments a methyl group; and

[00146] the sum of x+y+z is at least 1.

[00147] In formula (IB), R is in certain embodiments a linear or branched, acyclic alkyl or alkenyl group or an alkyl phenyl group; x, y, and z independently of one another, in certain embodiments represent numbers ranging from 2 to 100.

[00148] Examples of the alkoxyated polyamines for use in the present disclosure which correspond to formula (IB) include, for example, tetradecyloxypropyl-1,3-diaminopropane; a C12-14 alkyl oxypropyl-1,3-diaminopropane; a C12-15 alkyloxypropyl amine and other similar materials that are commercially available from Tomah under the tradename of TOMAH DA-17.

[00149] Other examples of alkoxyated polyamines of Formula (IB) are diamine compounds belonging to the JEFFAMINE series such as the JEFFAMINE D and JEFFAMINE ED series available from Huntsman Corporation, Salt Lake City, Utah. Examples of these Jeffamine compounds are JEFFAMINE D230, JEFFAMINE D400, JEFFAMINE D2000, JEFFAMINE D4000, JEFFAMINE HK-511, JEFFAMINE ED600, JEFFAMINE ED900, and JEFFAMINE ED2003. JEFFAMINE D series compounds are amine terminated PPGs (polypropylene glycols) and JEFFAMINE ED series compounds are polyether diamine based with a predominantly PEG (polyethylene glycol) backbone.

[00150] Other non-limiting preferred examples of suitable alkoxyated polyamines in the diamine form include compounds corresponding to formula (IIB):

[00151] $\text{NH}_2(\text{CH}_2)_x\text{OCH}_2\text{CH}_2\text{O}(\text{CH}_2)_x\text{NH}_2$

[00152] (IIB)

[00153] wherein x is 2 or 3.

[00154] Examples of alkoxyated polyamines of Formula (IIB) are diamine compounds belonging to the JEFFAMINE series available from Huntsman Corporation, Salt Lake City, Utah, such as JEFFAMINE EDR148, and JEFFAMINE EDR176.

[00155] Additional non-limiting preferred examples of alkoxyated polyamines in the triamine form include compounds corresponding to formula (IIIB):

[00156]
$$\text{NH}_2(\text{CHCH}_3\text{CH}_2\text{O})_x\text{CH}_2\text{C}(\text{R})\text{CH}_2(\text{OCH}_2\text{CHCH}_3)_z\text{NH}_2$$

[00157]
$$(\text{CH}_2)_n(\text{OCH}_2\text{CHCH}_3)_y\text{NH}_2$$

[00158] (IIIB)

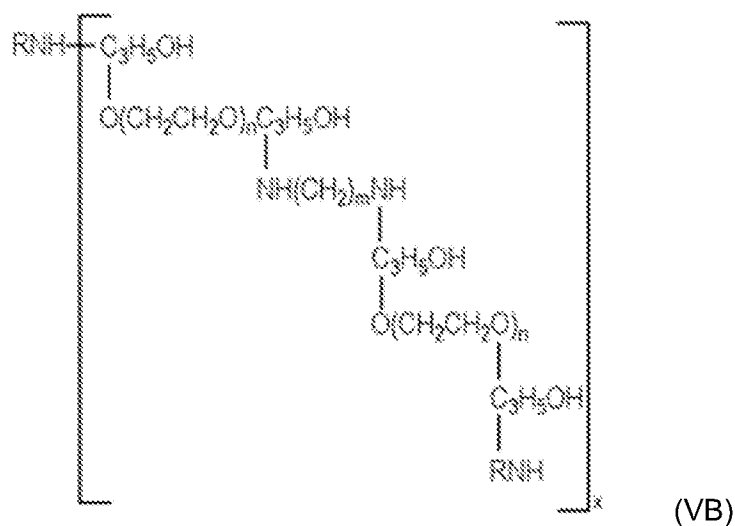
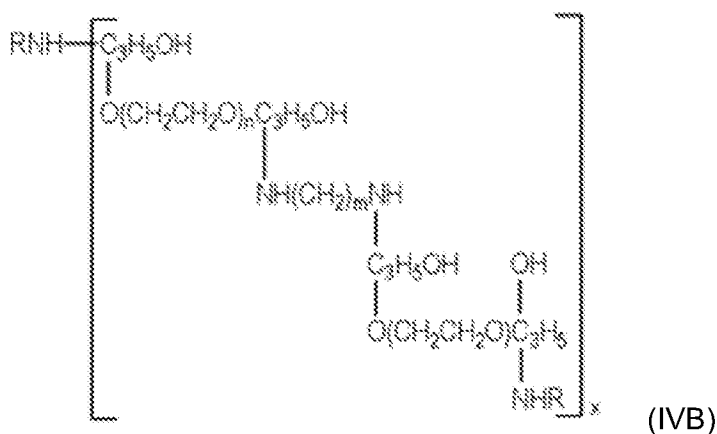
[00159] wherein R is hydrogen, $-\text{CH}_2$ or $-\text{C}_2\text{H}_5$,

[00160] $n=0$ or 1, and

[00161] x, y, and z independently of one another, represent numbers of from 0 to 100 and the sum of $x+y+z$ is at least 1.

[00162] Examples of alkoxyated polyamines for use in the present disclosure which correspond to formula (IIIB) are triamine compounds belonging to the JEFFAMINE series such as the JEFFAMINE T series available from Huntsman Corporation, Salt Lake City, Utah. Examples of the JEFFAMINE T series compounds are JEFFAMINE T403, JEFFAMINE T3000, and JEFFAMINE T5000. JEFFAMINE T series compounds are triamines made by reacting PO with a triol initiator followed by aminating the terminal hydroxyl groups.

[00163] Another type of preferred alkoxyated polyamines include compounds of formulas (IVB) and (VB) hereunder:



[00164] wherein

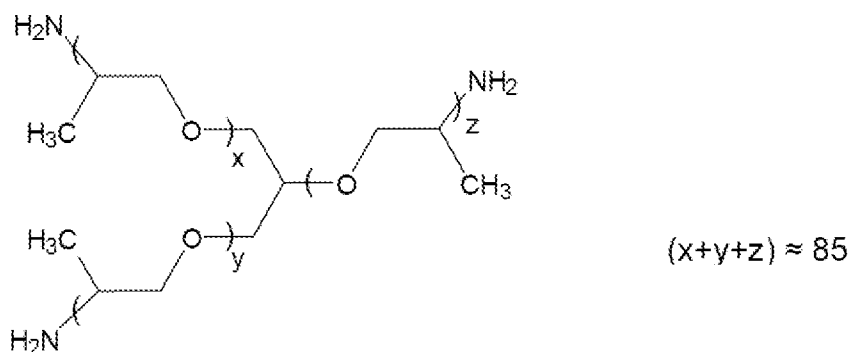
[00165] R in formula (IVB) represents the alkyl group derived from tallow and R in formula (VB) represents the alkyl group derived from coconut oil;

[00166] n in both formulas (IVB) and (VB) has a total value ranging from 10 to 20;

[00167] m in both formulas (IVB) and (VB) has a value ranging from 2 to 6; and

[00168] x in both formulas (IVB) and (VB) has a value ranging from 2 to 4.

[00169] One particular triamine alkoyleated polyamine compound is JEFFAMINE T-500 polyetheramine of the formula:



(VIB)

[00170] Other preferred types of alkoxyated polyamines include aminosilicones with at least one degree of alkoxylation.

[00171] Preferred examples of alkoxyated polyamines for use in the present disclosure include compounds of Formulas (IVB), (VB) and (VIB) above, such as PEG-15 Tallow Polyamine, PEG-15 Cocopolyamine, and JEFFAMINE T-500 polyetheramine, respectively.

[00172] Alkoxyated Monoamines

[00173] The alkoxyated monoamines of the present disclosure are chosen from amine compounds having at one amino groups and at least one degree of alkoxylation. The alkoxylation is provided by an alkylene oxide group which is in certain embodiments chosen from ethylene oxide and propylene oxide.

[00174] Non-limiting preferred examples of suitable alkoxyated monoamines include compounds corresponding to the formula (IC):

[00175] $RN[(R'CHCH_2O)_xH][(R'CHCH_2O)_yH]$

[00176] (IC)

[00177] wherein R is a hydrocarbon radical containing at least 6 carbon atoms. R can be linear or branched, acyclic or cyclic, saturated or unsaturated, aliphatic or aromatic, substituted or unsubstituted;

[00178] x and y, independently of one another, represent numbers of from 0 to 100 provided that the sum of x+y is >0;

[00179] the groups R', which may be identical or different, represent hydrogen, or an alkyl group such as a methyl group.

[00180] Typically, R is a linear or branched, acyclic alkyl or alkenyl group or an alkyl phenyl group; x and y, independently of one another, are each typically a number from 0 to 30. Typically, one R' group is hydrogen, and the other one is methyl.

[00181] Examples of preferred alkoxyated monoamines for use in the present disclosure which correspond to formula (IC) are PEG-2 Cocamine, PEG-3 Cocamine, PEG-5 Cocamine, PEG-10 Cocamine, PEG-15 Cocamine, PEG-20 Cocamine, PEG-2 Lauramine, PEG-12 Palmitamine, PEG-2 Rapeseedamine, PEG-2 Oleamine, PEG-5 Oleamine, PEG-6 Oleamine, PEG-10 Oleamine, PEG-15 Oleamine, PEG-20 Oleamine, PEG-25 Oleamine, and PEG-30 Oleamine. Other examples are alkoxyated derivatives of soyamine, stearamine and tallow amine.

[00182] Other non-limiting examples of suitable alkoxyated monoamines include compounds corresponding to formula (IIC):

[00183] $RNR''[(R'CHCH_2O)_xH]$

[00184] (IIC)

[00185] wherein R is a hydrocarbon radical containing at least 6 carbon atoms. R can be linear or branched, acyclic or cyclic, saturated or unsaturated, aliphatic or aromatic, substituted or unsubstituted;

[00186] x represents a number of from 1 to 100;

[00187] R' represents hydrogen, or an alkyl group such as in particular a methyl group; and

[00188] R'' is a hydrogen or a hydrocarbon radical.

[00189] Typically, R is a linear or branched, acyclic alkyl or alkenyl group or an alkyl phenyl group; x is typically a number from 1 to 30.

[00190] When R'' in formula (IIC) is a hydrocarbon radical group, this group may be linear or branched, saturated or unsaturated, substituted or unsubstituted. The hydrocarbon radical represented by R'' may also contain an alkoxyated moiety (as defined by $[(R'CHCH_2O)_yH]$), and/or heteroatoms such as nitrogen. When R''

contains at least one alkoxyated moiety, the total number of alkoxylation in the formula may range from 1 to 120.

[00191] Examples of alkoxyated monoamines for use in the present disclosure which correspond to formula (IIC) are PEG-3 Tallow Aminopropylamine, PEG-10 Tallow Aminopropylamine, PEG-15 Tallow Aminopropylamine, and PEG-105 Behenyl Propylenediamine.

[00192] Additional non-limiting examples of alkoxyated monoamines include compounds corresponding to formula (IIIC):

[00193] $R(R'CHCH_2O)_x(R'CHCH_2O)_yNH_2$

[00194] (IIIC)

[00195] wherein R is a hydrocarbon radical containing at least 6 carbon atoms. R can be linear or branched, acyclic or cyclic, saturated or unsaturated, aliphatic or aromatic, substituted or unsubstituted;

[00196] x and y, independently of one another, represent numbers of from 0 to 100 with the proviso that the sum of x+y is >0;

[00197] the groups R', which may be identical or different, represent hydrogen, or an alkyl group such as in particular a methyl group.

[00198] Typically, R is a linear or branched, acyclic alkyl or alkenyl group or an alkyl phenyl group; x and y, independently of one another, are each typically a number from 0 to 30.

[00199] Examples of alkoxyated monoamines for use in the present disclosure which correspond to formula (IIIC) are polyetheramines containing a monoamine group. These polyetheramines are commercially available from Hunstman under the tradename JEFFAMINE (M series such as M-600, M-1000, M-2005 and M-2070) and SURFONAMINE series (B-60, B-100, B-200, L-100, L-200, L-207, L-300).

[00200] Polyamines

[00201] The polyamines may in particular be chosen from polyvinylamines, aminated polysaccharides, amine substituted polyalkylene glycols, amine substituted polyacrylate crosspolymers, amine substituted polyacrylates, amine substituted polymethacrylates, proteins, protein derivatives, amine substituted polyesters,

polyamino acids, polyalkylamines, diethylene triamine, triethylenetetramine, spermidine, spermine and mixtures thereof. The polyamines for use in the present disclosure can also be chosen from aminosilicones having at least two amino groups.

[00202] The amino compound of the present disclosure selected from polyamines may be chosen from amine-containing polymers, in particular having a weight-average molecular weight ranging from 500 to 1,000,000, in certain embodiments ranging from 500 to 500,000, and preferentially ranging from 500 to 100,000. As amine-comprising polymer, use may be made of polyamines such as poly((C2-C5)alkyleneimines), and in particular polyethyleneimines and polypropyleneimines, especially poly(ethyleneimine)s; poly(allylamine); polyvinylamines and copolymers thereof, in particular with vinylamides; polyamino acids which have NH₂ groups; aminodextran; amino polyvinyl alcohol; acrylamidopropylamine-based copolymers; and chitosans.

[00203] The polyamines of the present disclosure are also in certain embodiments chosen from polyvinylamines which are generally sold under the trade name LUPAMINE or LUVIQUAT from BASF. One preferred example of such polyamines are polyvinylamines sold under the LUVIQUAT series such as Vinylamine/vinylformamide copolymer (INCI name), sold as LUVIQUAT 9030 by BASF.

[00204] The polyamines of the present disclosure may also be chosen from Vinylamine/Vinyl Alcohol Copolymer (INCI name).

[00205] Other preferred polyamines of the present disclosure include are amine substituted polyalkylene glycols such as PEG-15 cocopolyamine and PEG-15 Tallow Polyamine and amine substituted polyacrylate crosspolymer such as the product sold under the name CARBOPOL AQUA CC polymer by Lubrizol Advanced Materials, Inc.

[00206] The polyamine compound of the present disclosure may also be chosen from proteins and protein derivatives such as wheat protein, soy protein, oat protein, collagen, and keratin protein.

[00207] In an embodiment of the present disclosure, the polyamine compound is chosen from polyamino acid compounds comprising lysine, compounds comprising

arginine, compounds comprising histidine, and compounds comprising hydroxylysine. Non limiting examples include chitosan and polyamino acids such as polyarginine, polyhistidine, polylysine, and mixtures thereof.

[00208] In one preferred embodiment of the present disclosure, amino compound of the present disclosure is chosen from polyvinylamines such as Vinylamine/vinylformamide copolymer (INCI name), sold as LUVIQUAT 9030 by BASF; alkoxyated polyamines which correspond to formula (IIIB) such as JEFFAMINE T403, JEFFAMINE T3000, and JEFFAMINE T5000 (in particular, corresponds to formula (VIB); alkoxyated monoamines which correspond to formula (IIIC) such as JEFFAMINE M-600; and alkyl amines selected from aliphatic amines and amidoamines; and mixtures, thereof.

[00209] The alkyl amines selected from aliphatic amines are in certain embodiments chosen from dimethyl lauramine, dimethyl behenamine, dimethyl cocamine, dimethyl myristamine, dimethyl palmitamine, dimethyl stearamine, dimethyl tallowamine, dimethyl soyamine, stearamine, soyamine, cocamine, lauramine, palmitamine, oleamine, tallow amine, and mixtures thereof.

[00210] The alkyl amines selected from amidoamines are in certain embodiments chosen from stearamidopropyl dimethylamine, isostearamidopropyl dimethylamine, stearamidoethyl dimethylamine, lauramidopropyl dimethylamine, behenamidopropyl dimethylamine, dilinoleamidopropyl dimethylamine, babassuamidopropyl dimethylamine, cocamidopropyl dimethylamine, stearamidoethyldiethylamine, and mixtures thereof.

[00211] The amino compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines and mixtures thereof is typically present in the composition of the present disclosure in an amount of from about 0.15% to about 8%, by weight, in certain embodiments from about 0.2% to about 7%, by weight, and in certain embodiments from about 0.25% to about 5%, by weight, including all ranges and subranges therebetween, based on the total weight of the composition.

[00212] In various embodiments, the amount of the amino compound in the composition of the present disclosure is about 0.25%, 0.5%, 0.55%, 0.9%, 1%, 1.5%,

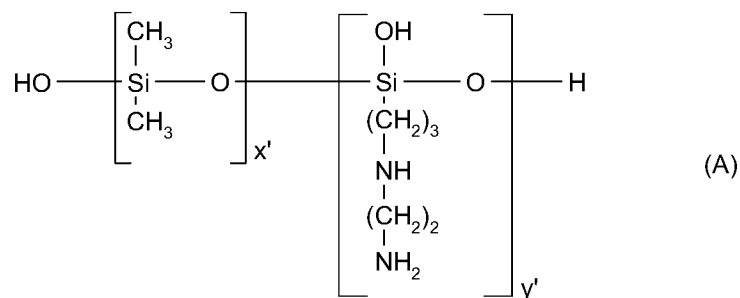
2%, 2.5%, 3%, 3.5%, 4%, 4.5%, 5%, 5.5%, 6%, 6.5%, 7%, 7.5%, and 8% by weight, based on the total weight of the composition.

[00213] AMINO SILICONE COMPOUNDS

[00214] The composition according to the invention comprises one or more amino silicone compounds. The terms “amino silicone compound” and, alternately, “silicone amine” are intended to mean any silicone comprising at least one primary, secondary or tertiary amine or a quaternary ammonium group.

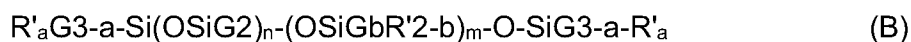
[00215] As amino silicone compounds that may be used in the scope of the invention, the following can be cited:

polysiloxanes corresponding to formula (A):



in which x' and y' are integers such that the weight-average molecular weight (Mw) is comprised between about 5000 and 500,000;

[00216] b) amino silicone compounds corresponding to formula (B):



in which:

G, which may be identical or different, designate a hydrogen atom, or a phenyl, OH or C1-C8 alkyl group, for example methyl, or C1-C8 alkoxy, for example methoxy,

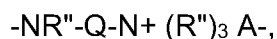
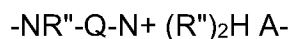
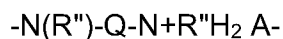
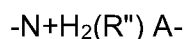
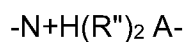
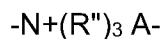
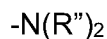
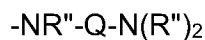
a, which may be identical or different, denote the number 0 or an integer from 1 to 3, in particular 0;

b denotes 0 or 1, and in particular 1;

m and n are numbers such that the sum ($n + m$) ranges from 1 to 2000 and in particular from 50 to 150, it being possible for n to denote a number from 0 to 1999

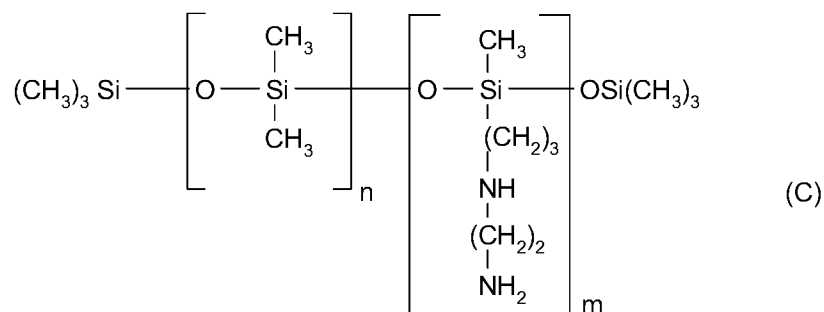
and in particular from 49 to 149, and for m to denote a number from 1 to 2000 and in particular from 1 to 10;

R', which may be identical or different, denote a monovalent radical having formula -C_qH_{2q}L in which q is a number ranging from 2 to 8 and L is an optionally quaternized amino group chosen from the following groups:



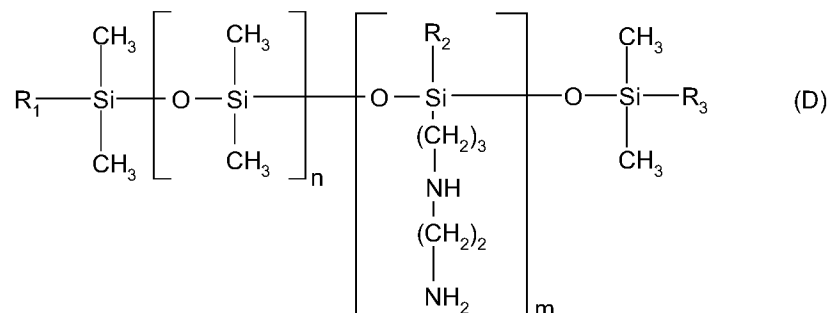
in which R'', which may be identical or different, denote hydrogen, phenyl, benzyl, or a saturated monovalent hydrocarbon-based radical, for example a C₁-C₂₀ alkyl radical; Q denotes a linear or branched C_rH_{2r} group, r being an integer ranging from 2 to 6, in certain embodiments from 2 to 4; and A⁻ represents a cosmetically acceptable ion, in particular a halide such as fluoride, chloride, bromide or iodide.

[00217] A group of amino silicone compounds corresponding to this definition (B) is represented by the silicones called "trimethylsilylamodimethicone" having formula (C):



in which n and m have the meanings given above, in formula B.

[00218] Another group of amino silicone compounds corresponding to this definition is represented by silicones having the following formulae (D) or (E):



in which:

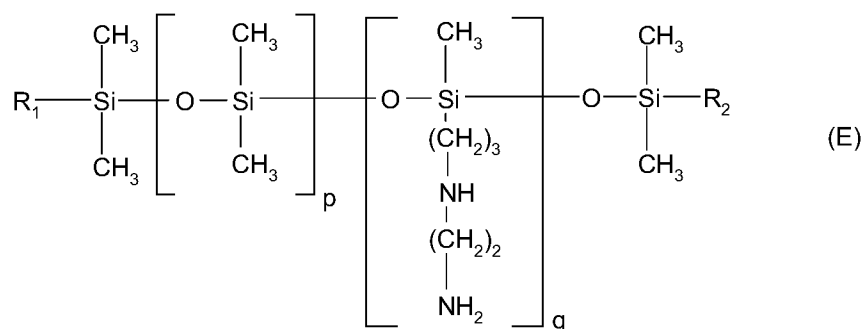
m and n are numbers such that the sum (n + m) can range from 1 to 1000, in particular from 50 to 250 and more particularly from 100 to 200, it being possible for n to denote a number from 0 to 999 and in particular from 49 to 249, and more particularly from 125 to 175, and for m to denote a number from 1 to 1000 and in particular from 1 to 10, and more particularly from 1 to 5;

R1, R2, R3, which may be identical or different, represent a hydroxy or C1-C4 alkoxy radical, where at least one of the radicals R1 to R3 denotes an alkoxy radical.

[00219] The alkoxy radical is in certain embodiments a methoxy radical.

[00220] The hydroxy/alkoxy mole ratio ranges in certain embodiments from 0.2:1 to 0.4:1 and in certain embodiments from 0.25:1 to 0.35:1 and more particularly equals 0.3:1.

[00221] The weight-average molecular weight (Mw) of the silicone ranges in certain embodiments from 2000 to 1 000 000, more particularly from 3500 to 200 000.



in which:

p and q are numbers such that the sum (p + q) ranges from 1 to 1000, particularly from 50 to 350, and more particularly from 150 to 250; it being possible for p to denote a number from 0 to 999 and in particular from 49 to 349, and more particularly from 159 to 239 and for q to denote a number from 1 to 1000, in particular from 1 to 10, and more particularly from 1 to 5;

R1, R2, which are different, represent a hydroxy or C1-C4 alkoxy radical, where at least one of the radicals R1 or R2 denotes an alkoxy radical.

[00222] The alkoxy radical is in certain embodiments a methoxy radical.

[00223] The hydroxy/alkoxy mole ratio ranges generally from 1:0.8 to 1:1.1 and in certain embodiments from 1:0.9 to 1:1 and more particularly equals 1:0.95.

[00224] The weight-average molecular weight (Mw) of the silicone ranges in certain embodiments from 2000 to 200 000, even more particularly 5000 to 100 000 and more particularly from 10 000 to 50 000.

[00225] Commercial products corresponding to these silicones having structure (D) or (E) may include in their composition one or more other amino silicone compounds whose structure is different than formulae (D) or (E).

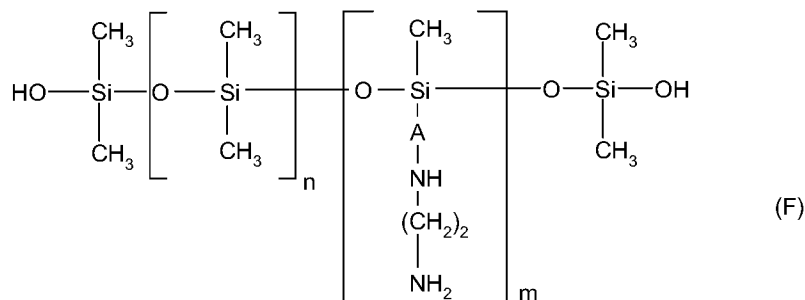
[00226] A product containing amino silicone compounds having structure (D) is sold by Wacker under the name BELSIL ADM 652.

[00227] A product containing amino silicone compounds having structure (E) is sold by Wacker under the name FLUID WR 1300®.

[00228] When these amino silicone compounds are used, one particularly advantageous embodiment consists in using them in the form of an oil-in-water emulsion. The oil-in-water emulsion may comprise one or more surfactants. The surfactants may be of any nature but are in certain embodiments cationic and/or nonionic. The number-average size of the silicone particles in the emulsion generally ranges from 3 nm to 500 nanometres. In certain embodiments, in particular as amino silicone compounds having formula (E), microemulsions are used whose average particle size ranges from 5 nm to 60 nanometres (limits included) and in certain embodiments from 10 nm to 50 nanometres (limits included). Accordingly, according

to the invention the microemulsions of amino silicone compound having formula (E) sold as FINISH CT 96 E® or SLM 28020® by Wacker can be used.

[00229] Another group of amino silicone compounds corresponding to this definition is represented by the following formula (F):



in which:

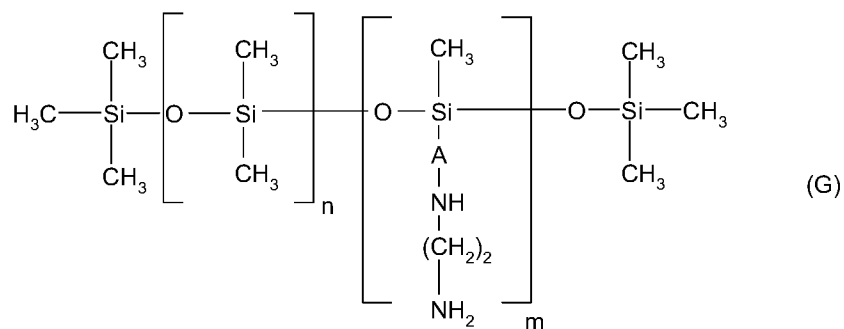
m and n are numbers such that the sum (n + m) ranges from 1 to 2000 and in particular from 50 to 150, it being possible for n to denote a number from 0 to 1999 and in particular from 49 to 149, and for m to denote a number from 1 to 2000 and in particular from 1 to 10;

A denotes a linear or branched alkylene radical containing from 4 to 8 carbon atoms and in certain embodiments 4 carbon atoms. This radical is in certain embodiments linear.

[00230] The weight-average molecular weight (Mw) of these amino silicone compounds ranges in certain embodiments from 2000 to 1 000 000 and even more particularly from 3500 to 200 000.

[00231] A preferred silicone of formula (F) is amodimethicone (INCI name) sold under the tradename XIAMETER® MEM-8299 Cationic Emulsion by Dow Corning.

[00232] Another group of amino silicone compounds corresponding to this definition is represented by the following formula (G):



in which:

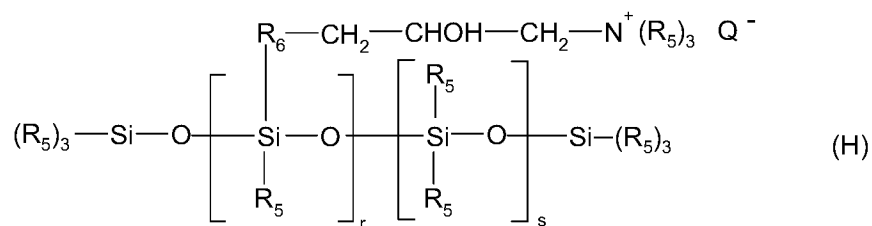
m and n are numbers such that the sum (n + m) ranges from 1 to 2000 and in particular from 50 to 150, it being possible for n to denote a number from 0 to 1999 and in particular from 49 to 149, and for m to denote a number from 1 to 2000 and in particular from 1 to 10;

A denotes a linear or branched alkylene radical containing from 4 to 8 carbon atoms and in certain embodiments 4 carbon atoms. This radical is in certain embodiments branched.

[00233] The weight-average molecular weight (Mw) of these amino silicone compounds ranges in certain embodiments from 500 to 1 000 000 and even more particularly from 1000 to 200 000.

[00234] A silicone having this formula is for example DC2-8566 Amino Fluid by Dow Corning.

[00235] c) amino silicone compounds corresponding to formula (H):



in which:

R5 represents a monovalent hydrocarbon-based radical containing from 1 to 18 carbon atoms, and in particular a C1-C18 alkyl or C2-C18 alkenyl radical, for example methyl;

R6 represents a divalent hydrocarbon-based radical, in particular a C1-C18 alkylene radical or a divalent C1-C18, for example C1-C8, alkyleneoxy radical linked to the Si via an SiC bond;

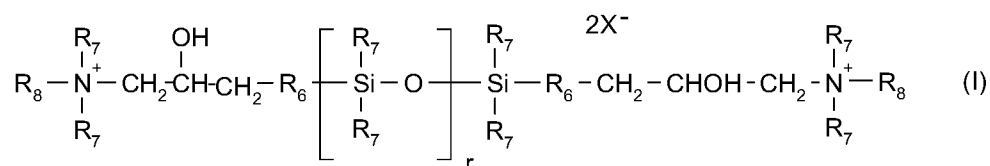
Q- is an anion such as a halide ion, in particular chloride, or an organic acid salt (for example acetate);

r represents a mean statistical value from 2 to 20 and in particular from 2 to 8;

s represents a mean statistical value from 20 to 200 and in particular from 20 to 50.

[00236] Such amino silicone compounds are described more particularly in patent US 4 185 087.

[00237] d) quaternary ammonium silicones having formula (I):



in which:

R7, which may be identical or different, represent a monovalent hydrocarbon-based radical containing from 1 to 18 carbon atoms, and in particular a C1-C18 alkyl radical, a C2-C18 alkenyl radical or a ring containing 5 or 6 carbon atoms, for example methyl;

R6 represents a divalent hydrocarbon-based radical, in particular a C1-C18 alkylene radical or a divalent C1-C18, for example C1-C8, alkyleneoxy radical linked to the Si via an SiC bond;

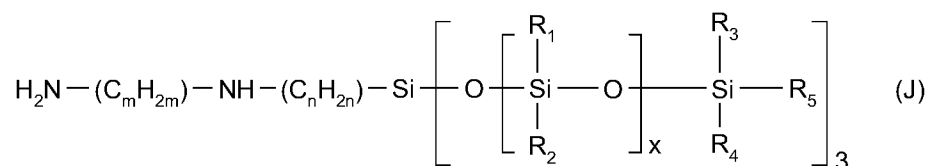
R8, which may be identical or different, represent a hydrogen atom, a monovalent hydrocarbon-based radical containing from 1 to 18 carbon atoms, and in particular a C1-C18 alkyl radical, a C2-C18 alkenyl radical or a -R6-NHCOR7 radical;

X- is an anion such as a halide ion, in particular chloride, or an organic acid salt (for example acetate);

r represents a mean statistical value from 2 to 200 and in particular from 5 to 100;

[00238] These silicones are described, for example, in patent application EP-A 0 530 974.

[00239] e) amino silicone compounds having formula (J):



in which:

R1, R2, R3 and R4, which may be identical or different, denote a C1-C4 alkyl radical or a phenyl group;

R5 denotes a C1-C4 alkyl radical or a hydroxyl group;

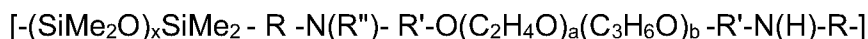
n is an integer ranging from 1 to 5;

m is an integer ranging from 1 to 5;

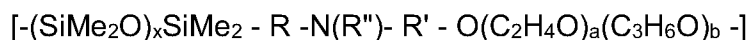
and in which x is chosen such that the amine number is between 0.01 and 1 meq/g;

[00240] f) multiblock polyoxyalkylenated amino silicone compounds, of type (AB)_n, A being a polysiloxane block and B being a polyoxyalkylenated block containing at least one amine group.

[00241] Said silicones are in certain embodiments constituted of repeating units having the following general formulae:



[00242] or alternatively



in which:

a is an integer greater than or equal to 1, in certain embodiments ranging from 5 to 200, more particularly ranging from 10 to 100;

b is an integer comprised between 0 and 200, in certain embodiments ranging from 4 to 100, more particularly between from 5 and 30;

x is an integer ranging from 1 to 10 000, more particularly from 10 to 5000;

R" is a hydrogen atom or a methyl;

R, which may be identical or different, represent a divalent linear or branched C2-C12 hydrocarbon-based radical, optionally including one or more heteroatoms such as oxygen; in certain embodiments, R denotes an ethylene radical, a linear or branched propylene radical, a linear or branched butylene radical, or a -CH₂CH₂CH₂OCH(OH)CH₂- radical; preferentially R denotes a -CH₂CH₂CH₂OCH(OH)CH₂- radical;

R', which may be identical or different, represent a divalent linear or branched C2-C12 hydrocarbon-based radical, optionally including one or more heteroatoms such as oxygen; in certain embodiments, R' denotes an ethylene radical, a linear or branched propylene radical, a linear or branched butylene radical, or a -CH₂CH₂CH₂OCH(OH)CH₂- radical; preferentially R' denotes -CH(CH₃)-CH₂-.

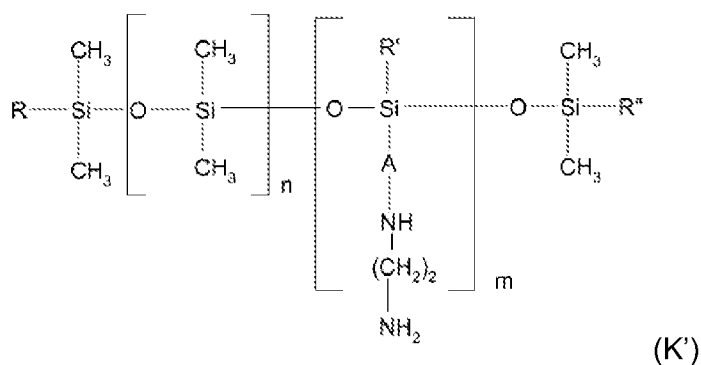
[00243] The siloxane blocks in certain embodiments represent between 50 and 95 mol% of the total weight of the silicone, more particularly from 70 to 85 mol%.

[00244] The amine content is in certain embodiments between 0.02 and 0.5 meq/g of copolymer in a 30% solution in dipropylene glycol, more particularly between 0,05 and 0,2.

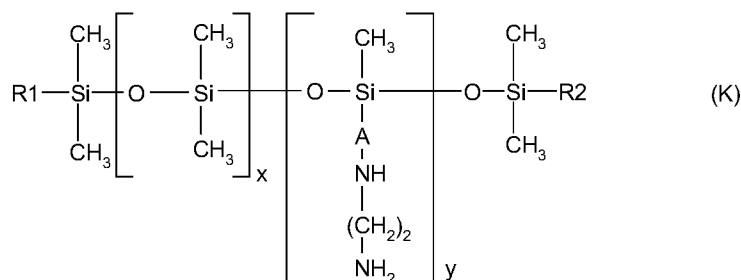
[00245] The weight-average molecular weight (Mw) of the silicone is in certain embodiments comprised between 5000 and 1 000 000, more particularly between 10 000 and 200 000.

[00246] Mention may be made especially of the silicones sold under the names SILSOFT A-843 or SILSOFT A+ by Momenite.

[00247] g) the alkylamino silicone compounds corresponding to formulas (K' and K) below:



in which R, R' and R'', which may be identical or different, each represent a C1-C4 alkyl or hydroxyl group, A represents a C3 alkylene group and m and n are such that the weight-average molecular mass of the compound is between 5000 and 500,000 approximately;



in which:

x and y are numbers ranging from 1 to 5000; in certain embodiments, x ranges from 10 to 2000 and especially from 100 to 1000; in certain embodiments, y ranges from 1 to 100;

R1 and R2, which may be identical or different, in certain embodiments identical, are linear or branched, saturated or unsaturated alkyl radicals, comprising 6 to 30 carbon atoms, in certain embodiments 8 to 24 carbon atoms and especially 12 to 20 carbon atoms;

[00248] A denotes a linear or branched alkylene radical containing from 2 to 8 carbon atoms,

[00249] In certain embodiments, A comprises 3 to 6 carbon atoms, especially 4 carbon atoms; in certain embodiments, A is branched. Mention may be made especially of the following divalent radicals: $-\text{CH}_2\text{CH}_2\text{CH}_2-$ and $-\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2-$.

[00250] In certain embodiments, R1 and R2, which may be identical or different, are saturated linear alkyl radicals comprising 6 to 30 carbon atoms, in certain embodiments 8 to 24 carbon atoms and especially 12 to 20 carbon atoms; mention may be made in particular of dodecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl and eicosyl radicals; and preferentially, R1 and R2, which may be identical or different, are chosen from hexadecyl (cetyl) and octadecyl (stearyl) radicals.

[00251] Preferentially, the silicone is of formula (K) with:

x ranging from 10 to 2000 and especially from 100 to 1000;

y ranging from 1 to 100;

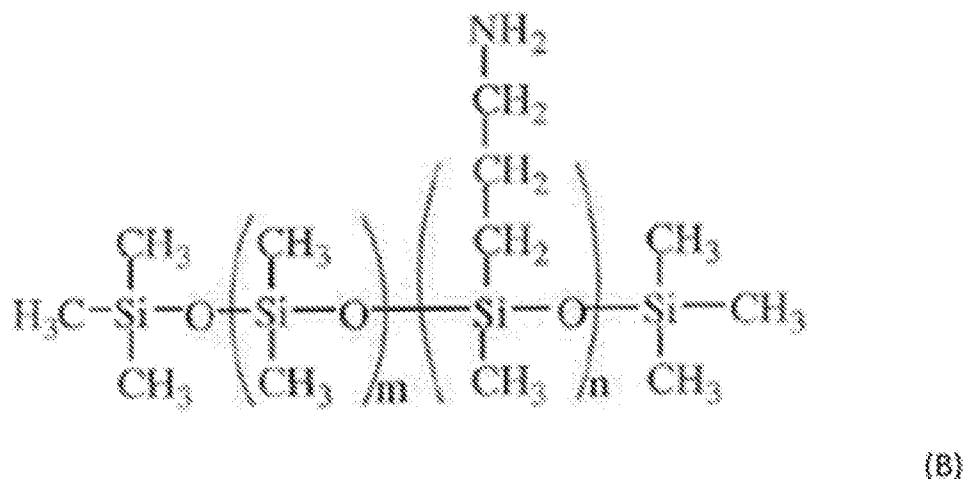
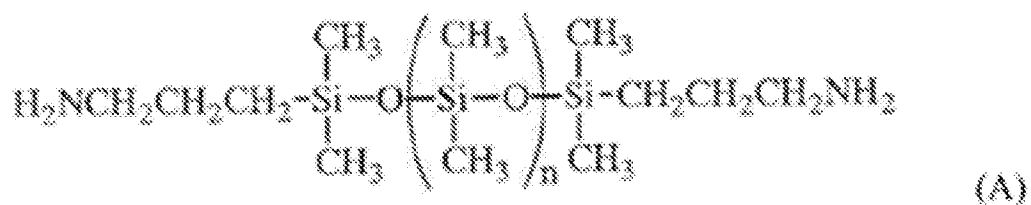
[00252] A comprising 3 to 6 carbon atoms and especially 4 carbon atoms; in certain embodiments, A is branched; and more particularly A is chosen from the following divalent radicals: $\text{CH}_2\text{CH}_2\text{CH}_2$ and $-\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2-$; and

R1 and R2, which may be identical or different, being linear, saturated alkyl radicals comprising 6 to 30 carbon atoms, in certain embodiments 8 to 24 carbon atoms and especially 12 to 20 carbon atoms; chosen in particular from dodecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl and eicosyl radicals; preferentially, R1 and R2, which may be identical or different, being chosen from hexadecyl (cetyl) and octadecyl (stearyl) radicals.

[00253] A preferred silicone of formula (K) is bis-cetearyl amodimethicone (INCI name).

[00254] Mention may be made especially of the silicone sold under the name SILSOFT AX by Momenite.

[00255] The amino silicone compounds of the present disclosure may also be chosen from polydimethylsiloxanes comprising primary amine groups at the chain end or on side chains, for example aminopropyl end or side groups, for instance those of formula (A) or (B) or (C):



[00256] In formula (A): the value of n is such that the weight-average molecular weight of the silicone is between 500 and 55 000. As an example of aminosilicone (A), mention may be made of those sold under the names DMS-A1 1, DMS-A12, DMS-A15, DMS-A21, DMS-A31, DMS-A32 and DMS-A35 by the company Gelest.

[00257] In formula (B), the values of n and m are such that the weight-average molecular weight of the silicone is between 1000 and 55 000. As examples of silicone (B), mention may be made of those sold under the names AMS-132, AMS-152, AMS-162, AMS-163, AMS-191 and AMS-1203 by the company Gelest.

[00258] In formula (C), the value of n is such that the weight-average molecular weight of the silicone is between 500 and 3000. As an example of silicone (C), mention may be made of those sold under the names MCR-A1 1 and MCR-A12 by the company Gelest.

[00259] In certain embodiments, the amino silicone compound according to the invention is amodimethicone (INCI name) such as the amodimethicone sold under the tradename KF 8020 from the supplier Shin Etsu or the tradename SILSOFT 253 from the supplier MOMENTIVE PERFORMANCE MATERIALS. Another preferred amino silicone compound is an amodimethicone of formula (F) sold under the tradename XIAMETER® MEM-8299 Cationic Emulsion by Dow Corning.

[00260] In other embodiments, the amino silicone according to the invention is chosen from bis-cetearyl amodimethicone (sold under the name SILSOFT AX by Momenitive).

[00261] The amino silicone compound is typically present in the composition of the present disclosure in an amount of from about 0.01% or from about 0.15% to about 8%, by weight, in certain embodiments from about 0.2% to about 7%, by weight, and in certain embodiments from about 0.25% to about 5%, by weight, including all ranges and subranges therebetween, based on the total weight of the composition.

[00262] In various embodiments, the amount of the amino silicone compound in the composition of the present disclosure is about 0.01%, 0.02%, 0.03%, 0.04%, 0.05%, 0.06%, 0.07%, 0.08%, 0.09%, 0.1%, 0.15%, 0.2%, 0.25%, 0.5%, 0.55%, 0.9%, 1%, 1.5%, 2%, 2.5%, 3%, 3.5%, 4%, 4.5%, 5%, 5.5%, 6%, 6.5%, 7%, 7.5%, and 8% by weight, based on the total weight of the composition.

[00263] Compositions comprising one or more of each of Polycarbodiimide and Amino Compounds Comprising Polyvinylamines for Hair Treatment

[00264] In accordance with some embodiments, the amino compound of the present disclosure is chosen from polyvinylamines (vinylformamide/vinylamine copolymer).

[00265] In certain embodiments, the amino compounds of the present disclosure do not contain silicon atoms or silicone moieties. In other embodiments, the amino compounds of the present disclosure contain silicon atoms or silicone moieties.

[00266] In accordance with the various embodiments, the amino compound chosen from polyvinylamines is present in the compositions according to the disclosure in amounts range from about 0.01% to about 40%, and in some embodiments from about 0.1% to about 20%, and in some further embodiments from

about 0.1% to about 15%. In some representative embodiments, the amino compound chosen from polyvinylamines is present from about 0.25% to about 10%, and from about 0.5% to about 5%. In yet other embodiments, the amino compound chosen from polyvinylamines is present from at least 0.5%. And in yet other embodiments, the amino compound chosen from polyvinylamines is present from at least 0.5% to up to about 40%. In some specific embodiments, the amino compound chosen from polyvinylamines is present at about 1.5%. In some other specific embodiments, the amino compound chosen from polyvinylamines is present at about 0.75%. In some other specific embodiments, the amino compound chosen from polyvinylamines compound is present at about 0.25%.

[00267] Thus, the amino compound chosen from polyvinylamines may be present from about 0.01, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 to about 40 percent by weight, including increments and ranges therein and there between.

[00268] Compositions comprising one or more of each of Polycarbodiimide and Amino compounds selected from polyamines and amino silicones for Hair Color

[00269] In accordance with the various embodiments, the amino compound chosen from polyamines is present in the compositions according to the disclosure in amounts range from about 0.01% to about 40%, and in some embodiments from about 0.1% to about 20%, and in some further embodiments from about 0.1% to about 15%. In some representative embodiments, the amino compound chosen from polyamines is present from about 0.25% to about 10%, and from about 0.5% to about 5%. In yet other embodiments, the amino compound chosen from polyamines is present from at least 0.5%. And in yet other embodiments, the amino compound chosen from polyamines is present from at least 0.5% to up to about 40%. In some specific embodiments, the amino compound chosen from polyamines is present at about 1.5%. In some other specific embodiments, the amino compound chosen from polyamines is present at about 0.75%. In some other specific embodiments, the amino compound chosen from polyamines compound is present at about 0.25%.

[00270] Thus, the amino compound chosen from polyamines may be present from about 0.01, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,

11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 to about 40 percent by weight, including increments and ranges therein and there between.

[00271] In accordance with some particular embodiments, the polyamines are selected from polyvinylamines.

[00272] Further, in accordance with the various embodiments, the amino compound chosen from silicone amines is present in the compositions according to the disclosure in amounts range from about 0.01% to about 40%, and in some embodiments from about 0.1% to about 20%, and in some further embodiments from about 0.1% to about 15%. In some representative embodiments, the amino compound chosen from silicone amines is present from about 0.25% to about 10%, and from about 0.5% to about 5%. In yet other embodiments, the amino compound chosen from silicone amines is present from at least 0.5%. And in yet other embodiments, the amino compound chosen from silicone amines is present from at least 0.5% to up to about 40%. In some specific embodiments, the amino compound chosen from silicone amines is present at about 1.5%. In some other specific embodiments, the amino compound chosen from silicone amines is present at about 0.75%. In some other specific embodiments, the amino compound chosen from silicone amines compound is present at about 0.25%.

[00273] Thus, the amino compound chosen from silicone amines may be present from about 0.01, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39 to about 40 percent by weight, including increments and ranges therein and there between.

[00274] In accordance with some particular embodiments, the silicone amines are selected from side chain amino silicones. In some examples, the silicone amines are selected from amodimethicones.

[00275] Optional Colorants

[00276] Colorants

[00277] It is known practice to dye the hair with dye compositions comprising oxidation dye precursors, which are generally known as oxidation bases. These oxidation bases are colorless or weakly colored compounds, which, when combined

with oxidizing products, give rise to colored compounds via a process of oxidative condensation. It is also known that the shades obtained with these oxidation bases can be varied by combining them with couplers or coloration modifiers. The variety of molecules used as oxidation bases and couplers allows a wide range of colors to be obtained. Dye compositions comprising oxidation dye precursors are typically combined with an oxidizing composition containing an oxidizing agent; the oxidizing composition may also be called "developer composition".

[00278] It is also known practice to dye the hair by direct dyeing. The process conventionally used in direct dyeing consists in applying to the hair direct dyes, which are colored and coloring molecules that have affinity for the hair, in leaving them to stand on the hair and then in rinsing the fibers.

[00279] The colorations resulting therefrom are particularly chromatic colorations but are, however, only temporary or semi-permanent since the nature of the interactions that bind the direct dyes to the keratin fiber and their desorption from the surface and/or the core of the fiber are responsible for their weak dyeing power and their poor fastness with respect to washing.

[00280] In certain hair coloration practices, dye compositions comprise both oxidation dye precursors and direct dyes to obtain other shades and improve the color fastness of the dyes/colorants to hair. Such dye compositions may also be combined with an oxidizing composition.

[00281] An oxidizing composition includes at least one oxidizing agent which may be chosen, for example, from peroxides, persulfates, perborates percarbonates, alkali metal bromates, ferricyanides, peroxygenated salts, or a mixture thereof. Oxidizing agents that may also be used include at least one redox enzyme such as laccases, peroxidases, and 2-electron oxidoreductases, such as uricase, where appropriate in the presence of their respective donor or co-factor. Oxygen in the air may also be employed as an oxidizing agent.

[00282] In one embodiment, the oxidizing agent is hydrogen peroxide present in an aqueous solution whose titre may range from 1 to 40 volumes, such as from 5 to 40 volumes or such as from 5 to 20 volumes.

[00283] In another embodiment, the oxidizing agent is a persulfate and/or a monopersulfate such as, for example, potassium persulfate, sodium persulfate,

ammonium persulfate, as well as mixtures thereof. In one embodiment, the oxidizing agents are selected from hydrogen peroxide, potassium persulfate, sodium persulfate, and mixtures thereof.

[00284] In general, the oxidizing agent will be present in an amount of from about 0.05 to about 50% by weight, such as from about 0.1% to about 30% by weight, or such as from about 0.1% to about 20% by weight, or such as from about 1% to about 10% by weight, based on the total weight of the oxidizing composition.

[00285] The oxidizing composition can contain at least one solvent, chosen from water, organic solvents, and mixtures thereof.

[00286] Suitable organic solvents for use in the oxidizing composition include ethanol, isopropyl alcohol, propanol, benzyl alcohol, phenyl ethyl alcohol, glycols and glycol ethers, such as propylene glycol, hexylene glycol, ethylene glycol monomethyl, monoethyl or monobutyl ether, propylene glycol and its ethers, such as propylene glycol monomethyl ether, butylene glycol, dipropylene glycol, diethylene glycol alkyl ethers, such as diethylene glycol monoethyl ether and monobutyl ether, ethylene glycol, propylene glycol, butylene glycol, hexylene glycol, propane diol, glycerin, hydrocarbons such as straight chain hydrocarbons, mineral oil, polybutene, hydrogenated polyisobutene, hydrogenated polydecene, polydecene, squalane, petrolatum, isoparaffins, and mixtures, thereof.

[00287] The oxidizing composition may be in the form of a powder, gel, liquid, foam, lotion, cream, mousse, and emulsion.

[00288] Typically, a dye composition containing oxidative dye precursor can be mixed with an oxidizing composition in a ratio by weight of from about 1:0.01 to about 1:10, such as from about 1:0.01 to about 1:0.05, from about 1:0.05 to about 1:0.1, from about 1:0.1 to about 1:0.5, from about 1:0.5 to about 1:1, from about 1:1 to about 1:2, from about 1:2 to about 1:3, from about 1:3 to about 1:4, from about 1:4 to about 1:5, from about 1:5 to about 1:10. Thus, in accordance with the various embodiments, a dye composition containing oxidative dye precursor can be mixed or combined with an oxidizing composition in a ratio, by weight, from 1 to one of about 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, including increments and ranges therein and there between from about 1:0.01 to about 1:10.

[00289] SOLVENT

[00290] The composition, according to the present disclosure, further includes suitable solvents for treatment of keratinous fibers. Examples of suitable solvents include water, in some embodiments, distilled or de-ionised, or organic solvents as a carrier and solvent for the polycarbodiimides and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof and optional colorants or dyes, and mixtures thereof.

[00291] Suitable organic solvents may be chosen from volatile and nonvolatile organic solvents.

[00292] Suitable organic solvents are typically C1-C4 lower alcohols, glycols, polyols, polyol ethers, hydrocarbons, and oils. Examples of organic solvents include, but are not limited to, ethanol, isopropyl alcohol, benzyl alcohol, phenyl ethyl alcohol, isododecane, propylene glycol, pentyleneglycol, hexyleneglycol, glycerol, and mixtures thereof.

[00293] Other suitable organic solvents include glycol ethers, for example, ethyleneglycol and its ethers such as ethyleneglycol monomethylether, ethyleneglycol monopropylether, ethyleneglycol monobutylether, propyleneglycol and its ethers, such as propyleneglycol monomethylether, propyleneglycol monopropylether, propyleneglycol monobutylether, dipropyleneglycol and diethyleneglycol alkyl ethers, such as diethyleneglycol monoethylether, diethyleneglycol monobutylether, and dipropyleneglycol n-butylether. Glycol ethers are commercially available from The Dow Chemical Company under the DOW E-series and DOW P-series. An exemplary glycol ether for use in the present invention is dipropyleneglycol n-butylether, known under the tradename of DOWANOL DPnB.

[00294] Suitable organic solvents also include synthetic oils and hydrocarbon oils include mineral oil, petrolatum, and C10-C40 hydrocarbons which may be aliphatic (with a straight, branched or cyclic chain), aromatic, arylaliphatic such as paraffins, iso-paraffins, isododecanes, aromatic hydrocarbons, polybutene, hydrogenated polyisobutene, hydrogenated polydecene, polydecene, squalene, petrolatum and isoparaffins, silicone oils, fluoro oils and mixtures, thereof.

[00295] The term "hydrocarbon based oil" or "hydrocarbon oil" refers to oil mainly containing hydrogen and carbon atoms and possibly oxygen, nitrogen, sulfur and/or phosphorus atoms. Representative examples of hydrocarbon based oils include oils containing from 8 to 16 carbon atoms, and especially branched C8 C16 alkanes (also known as isoparaffins), for instance isododecane (also known as 2,2,4,4,6 pentamethylheptane), isodecane and isohexadecane.

[00296] Examples of silicone oils that may be useful in the present invention include nonvolatile silicone oils such as polydimethylsiloxanes (PDMS), polydimethylsiloxanes comprising alkyl or alkoxy groups that are pendent and/or at the end of a silicone chain, these groups each containing from 2 to 24 carbon atoms, phenyl silicones, for instance phenyl trimethicones, phenyl dimethicones, phenyl trimethylsiloxy diphenylsiloxanes, diphenyl dimethicones, diphenyl methyldiphenyl trisiloxanes and 2 phenylethyl trimethylsiloxysilicates, and dimethicones or phenyltrimethicones with a viscosity of less than or equal to 100 cSt.

[00297] Other representative examples of silicone oils that may be useful in the present invention include volatile silicone oils such as linear or cyclic silicone oils, and especially containing from 2 to 10 silicon atoms and in particular from 2 to 7 silicon atoms, these silicones optionally comprising alkyl or alkoxy groups containing from 1 to 10 carbon atoms. Specific examples include dimethicones with a viscosity of 5 and 6 cSt, octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, dodecamethylcyclohexasiloxane, heptamethylhexyltrisiloxane, heptamethyloctyltrisiloxane, hexamethyldisiloxane, octamethyltrisiloxane, decamethyltetrasiloxane and dodecamethylpentasiloxane, and mixtures thereof.

[00298] Representative examples of fluoro oils that may be suitable for use in the present invention include volatile fluoro oils such as nonafluoromethoxybutane and perfluoro methylcyclopentane.

[00299] Particularly suitable solvents in a composition of the present disclosure include water, isododecane, ethanol, and combinations thereof. The solvent will typically be present in total amounts ranging from about 60% to 98%, in some embodiments, from 80% to 96%, by weight, including all ranges and subranges therebetween, based on the total weight of the composition. Thus, solvents may be present in amounts of about 98%, 97%, 96%, 95%, 94%, 93%, 92%, 91%, 90%,

85%, 80%, 75%, 70%, 65%, 60%, and about 55%, 50%, 48%, 46%, 45%, 44%, 42%, 40%, by weight, based on the total weight of the composition, including increments and ranges therein and there between from about 40% to about 98%.

[00300] In yet some other embodiments, the solvent of the present disclosure does not comprise water and/or organic solvent that is added as a separate ingredient, by itself, into the compositions of the present invention, such that water and/or organic solvent is present in the compositions of the present invention when it accompanies one or more ingredients of a raw material that is added into the compositions of the invention.

[00301] When the compositions of the disclosure contain water, according to various embodiments, water can be present in amounts of about 98% or less, such as about 96%, 95%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55%, 50%, 48%, 46%, 45%, 44%, 42%, 40%, 35%, 30%, 20%, 10%, or 5% or less, by weight, based on the total weight of the composition, including increments and ranges therein and there between.

[00302] When the compositions of the disclosure contain an organic solvent(s), according to various embodiments, the organic solvent(s) can be present in a total amount of about 98% or less, such as about 96%, 95%, 90%, 85%, 80%, 75%, 70%, 65%, 60%, 55%, 50%, 48%, 46%, 45%, 44%, 42%, 40%, 35%, 30%, 20%, 10%, or 5% or less, by weight, based on the total weight of the composition, including increments and ranges therein and there between.

[00303] ADDITIVES

[00304] The composition, according to the present disclosure, further includes suitable additives for treatment of keratinous fibers.

[00305] The composition according to the disclosure may also comprise additives chosen from amine or amino compounds (other than the amino compounds of the invention), surfactants (anionic, nonionic, cationic and amphoteric/zwitterionic), and polymers other than the polycarbodiimide of the invention such as anionic polymers, nonionic polymers, amphoteric polymers, polymeric rheology modifiers, thickening and/or viscosity modifying agents, associative or non-associative polymeric thickeners. Other suitable additives may be chosen from non-polymeric thickeners, nacreous agents, opacifiers, dyes or pigments, fragrances, mineral, plant or

synthetic oils, waxes including ceramides, vitamins, UV-screening agents, free-radical scavengers, antidandruff agents, hair-loss counteractants, hair restorers, preserving agents, pH stabilizers and solvents, and mixtures thereof.

[00306] The compositions of certain embodiments may comprise stabilizers, for example sodium chloride, magnesium dichloride or magnesium sulfate.

[00307] The amine or amino compounds that may be employed in the compositions of the present disclosure are not chosen from the amino silicones of the invention. The term "amino" is intended to mean refer to a primary, secondary or tertiary amine or a quaternary ammonium group.

[00308] The amine or amino compounds that may be employed in the compositions of the present disclosure may also be chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, and polyamines, in particular, those that do not contain silicon atoms or silicone moieties. In some embodiments, amino silicones that may be employed in the compositions of the present disclosure may be chosen from polysiloxanes having at least one primary, secondary or tertiary amine group such as trimethylsilylamodimethicones, quaternary ammonium silicones, multiblock polyoxyalkylenated amino silicones, of type (AB)_n, A being a polysiloxane block and B being a polyoxyalkylenated block containing at least one amine group, alkyl amino silicones, and mixtures thereof

[00309] Suitable examples of the amine or amino silicone compounds include amodimethicone (e.g., sold under the name KF 8020 by Shin Etsu or XIAMETER® MEM-8299 Cationic Emulsion by Dow Corning), and bis-cetearyl amodimethicone (sold under the name SILSOFT AX by Momenite).

[00310] Suitable examples of alkyl monoamines include, but are not limited to the following examples: dimethyl lauramine, dimethyl behenamine, dimethyl cocamine, dimethyl myristamine, dimethyl palmitamine, dimethyl stearamine, dimethyl tallowamine, dimethyl soyamine, stearamine, soyamine, cocamine, lauramine, palmitamine, oleamine, tallow amine and mixtures thereof.

[00311] The alkyl monoamines may also be chosen from amidoamines, including, but not limited to the following examples: oleamidopropyl dimethylamine, stearamidopropyl dimethylamine, isostearamidopropyl dimethylamine,

stearamidoethyl dimethylamine, lauramidopropyl dimethylamine, palmitamidopropyl dimethylamine, stearamidoethyldiethylamine, and mixtures thereof.

[00312] The alkoxyated polyamines that may be employed in the compositions of the present disclosure are chosen from amino compounds having at least two amino groups and at least one degree of alkoxylation provided by an alkylene oxide group which is in certain embodiments chosen from ethylene oxide and propylene oxide.

[00313] Suitable examples of alkoxyated polyamines include, but are not limited to diamine and triamine compounds belonging to the JEFFAMINE series such as the JEFFAMINE D, JEFFAMINE ED, JEFFAMINE EDR, and JEFFAMINE T series available from Huntsman Corporation.

[00314] The alkoxyated monoamines that may be employed in the compositions of the present disclosure are chosen from amino compounds having at one amino groups and at least one degree of alkoxylation provided by an alkylene oxide group which is in certain embodiments chosen from ethylene oxide and propylene oxide.

[00315] Suitable examples are alkoxyated derivatives of cocamine, lauramine, palmitamine, rapeseedamine, oleamine, soyamine, stearamine, tallow amine, tallow aminopropylamine, behenyl propylenediamine and those of the JEFFAMINE M series from Huntsman.

[00316] The polyamines that may be used in the compositions of the present disclosure may in particular be chosen from aminosilicones, polyvinylamines, aminated polysaccharides, amine substituted polyalkylene glycols, amine substituted polyacrylate crosspolymers, amine substituted polyacrylates, amine substituted polymethacrylates, proteins, protein derivatives, amine substituted polyesters, polyamino acids, polyalkylamines, diethylene triamine, triethylenetetramine, spermidine, spermine and mixtures thereof.

[00317] The rheology modifiers and thickening/viscosity-modifying agents that may be employed in compositions of the present disclosure may include any water-soluble or water-dispersible compound that is compatible with the polycarbodiimide, one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, and compositions of the disclosure, such as acrylic polymers (in particular, Acrylates/C10-30 Alkyl Acrylate Crosspolymer, carbomers, acrylate copolymers,

acrylate crosspolymers), non-acrylic polymers, starch, saccharide-based polymers (e.g., guar, guar gums), cellulose-based polymers (in particular, hydroxyethylcellulose, cellulose gums, alkyl hydroxyethyl cellulose, carboxylic acid containing celluloses/carbohydrates), non-polymeric and polymeric gelling agents, silica particles, clay, hyaluronic acid, alginic acid, and mixtures thereof.

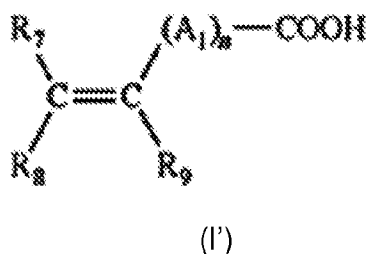
[00318] OTHER ADDITIVES

[00319] Polycarboxylic acid Polymer Compounds

[00320] The polycarboxylic acid, compounds of the present disclosure may be chosen from anionic, nonionic, and amphoteric polymers.

[00321] The anionic polymers may be soluble in a cosmetically acceptable medium or insoluble in this same medium such that they may be used in the form of dispersions of solid or liquid particles of polymer (latex or pseudolatex).

[00322] The anionic polymers may be selected from polymers comprising groups derived from carboxylic acids, and have an average molecular weight by number of between about 500 and 5,000,000. The carboxylic groups are provided by unsaturated mono- or diacid carboxylic monomers such as those that have the formula:



in which n is an integer from 0 to 10, A₁ denotes a methylene group optionally joined to the carbon atom of the unsaturated group or to the adjacent methylene group when n is greater than 1, via a heteroatom such as oxygen or sulfur, R₇ denotes a hydrogen atom or a phenyl or benzyl group, R₈ denotes a hydrogen atom or a lower alkyl or carboxyl group, and R₉ denotes a hydrogen atom, a lower alkyl group, a CH₂-COOH, phenyl or benzyl group.

[00323] In the abovementioned formula, a lower alkyl group in certain embodiments denotes a group containing 1 to 4 carbon atoms and in particular methyl and ethyl groups.

[00324] The polycarboxylic acid compounds include Copolymers of acrylic or methacrylic acid or salts thereof, and in particular copolymers of acrylic acid and acrylamide sold in the form of their sodium salts;

[00325] The polycarboxylic acid compounds include Copolymers of acrylic or methacrylic acid with a monoethylenic monomer such as ethylene, styrene, vinyl esters and acrylic or methacrylic acid esters, optionally grafted onto a polyalkylene glycol such as polyethylene glycol and optionally crosslinked. The polycarboxylic acid compounds include methacrylic acid/acrylic acid/ethyl acrylate/methyl methacrylate copolymers in an aqueous dispersion.

[00326] The polycarboxylic acid compounds include Crotonic acid copolymers, such as those comprising vinyl acetate or propionate units in their chain and optionally other monomers such as allyl esters or methallyl esters, vinyl ether or vinyl ester of a linear or branched saturated carboxylic acid with a long hydrocarbon-based chain, such as those containing at least 5 carbon atoms, it being possible for these polymers optionally to be grafted or crosslinked, or alternatively another vinyl, allyl or methallyl ester monomer of an [alpha]- or [beta]-cyclic carboxylic acid.

[00327] The polycarboxylic acid compounds include Copolymers of C4-C8 monounsaturated carboxylic acids selected from: copolymers comprising (i) one or more maleic, fumaric, itaconic, allyloxyacetic, methallyloxyacetic, 3-allyloxypropionic, allylthioacetic, allylaminoacetic, vinylacetic, vinyloxyacetic, crotyloxyacetic, 3-butenic, 4-pentenoic, 10-undecenoic, allylmalonic, maleamic, itaconamic, N-monohydroxyalkyl- or N-dihydroxy-alkyl-maleamic acids and (ii) at least one monomer selected from vinyl esters, vinyl ethers, vinyl halides, phenylvinyl derivatives, acrylic acid and its esters, the anhydride functions of these copolymers optionally being monoesterified or monoamidated. The polycarboxylic acid compounds include copolymers comprising (i) one or more maleic, citraconic or itaconic anhydride units and (ii) one or more monomers selected from allyl or methallyl esters optionally comprising one or more acrylamide, methacrylamide, [alpha]-olefin, acrylic or methacrylic ester, acrylic or methacrylic acid or vinylpyrrolidone groups in their chain, the anhydride functions of these copolymers optionally being monoesterified or monoamidated. The polycarboxylic acid compounds include polyacrylamides comprising carboxylate groups.

[00328] The polycarboxylic acid compounds of the present disclosure may also include those anionic polymers as sold under the FIXATE series as commercially available from Lubrizol, such as a branched block anionic polymer sold as FIXATE G-100, a branched anionic acrylate copolymer Polyacrylate-2 Crosspolymer (FIXATE SUPERHOLD polymer), Acrylates Crosspolymer-3 (FIXATE FREESTYLE Polymer), Polyacrylate-14 (FIXATE PLUS Polymer), those sold under the CARBOPOL series as commercially available from Lubrizol such as Acrylates Crosspolymer-4 (CARBOPOL AQUA SF-2), Acrylates Crosspolymer-4 (CARBOPOL AQUA CC), and those sold under the SYNTRAN series as commercially available from Interpolymer such as Acrylates Copolymer (SYNTRAN 5190), Styrene/Acrylates/Ammonium Methacrylate Copolymer (SYNTRAN 5760), and Ammonium Acrylates Copolymer (SYNTRAN KL-219C).

[00329] The polycarboxylic acid compounds of the present disclosure also includes anionic latex polymers such as acrylic copolymer and (meth)acrylate copolymers dispersions.

[00330] The polycarboxylic acid compounds include copolymers of acrylic acid or of acrylic esters, such as Acrylates/t-Butylacrylamide copolymer sold as ULTRAHOLD 8, acrylic acid/ethyl acrylate/N-tert-butylacrylamide terpolymers sold especially as ULTRAHOLD STRONG by BASF, copolymers derived from crotonic acid, such as vinyl acetate/vinyl tert-butylbenzoate/crotonic acid terpolymers and the crotonic acid/vinyl acetate/vinyl neododecanoate terpolymers sold especially as RESYN 28-29-30 by Azko Nobel, polymers derived from maleic, fumaric or itaconic acids or anhydrides with vinyl esters, vinyl ethers, vinyl halides, phenylvinyl derivatives and acrylic acid and esters thereof, such as the methyl vinyl ether/monoesterified maleic anhydride copolymers sold, for example, as GANTREZ AN or ES by ISP, the copolymers of methacrylic acid and methyl methacrylate sold as EUDRAGIT L by Rohm Pharma, the copolymers of methacrylic acid and ethyl acrylate sold as LUVIMER MAEX or MAE by BASF, the vinyl acetate/crotonic acid copolymers sold as LUVISET CA 66 by BASF, the vinyl acetate/crotonic acid copolymers grafted with polyethylene glycol sold as ARISTOFLEX A by BASF, and the polymer sold as FIXATE G-100 by Noveon.

[00331] The polycarboxylic acid compounds include amphoteric polymers which may be selected from the following polymers:

copolymers having acidic vinyl units and basic vinyl units, such as those resulting from the copolymerization of a monomer derived from a vinyl compound bearing a carboxylic group such as, more particularly, acrylic acid, methacrylic acid, maleic acid, alpha-chloroacrylic acid, and a basic monomer derived from a substituted vinyl compound containing at least one basic atom, such as, more particularly, dialkylaminoalkyl methacrylate and acrylate, dialkylaminoalkylmethacrylamides and acrylamides. Such compounds are described in U.S. Pat. No. 3,836,537.

[00332] The polycarboxylic acid compounds include Polymers comprising units derived from:

at least one monomer selected from acrylamides and methacrylamides substituted on the nitrogen atom with an alkyl group,

at least one acidic comonomer containing one or more reactive carboxylic groups, selected more particularly from acrylic, methacrylic, crotonic, itaconic, maleic and fumaric acid and alkyl monoesters, having 1 to 4 carbon atoms, of maleic or fumaric acid or anhydride, and

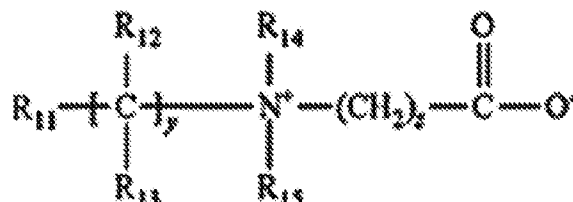
at least one basic comonomer such as esters with primary, secondary, tertiary or quaternary amine substituents of acrylic and methacrylic acids and the product of quaternization of dimethylaminoethyl methacrylate with dimethyl or diethyl sulfate. The N-substituted acrylamides or methacrylamides that are more particularly preferred according to the invention are compounds in which the alkyl groups contain from 2 to 12 carbon atoms and more particularly N-ethylacrylamide, N-tert-butylacrylamide, N-tert-octylacrylamide, N-octylacrylamide, N-decylacrylamide, N-dodecylacrylamide and the corresponding methacrylamides. The preferred basic comonomers are aminoethyl, butylaminoethyl, N,N'-dimethylaminoethyl and N-tert-butylaminoethyl methacrylates.

[00333] The copolymers whose CTFA (4th edition, 1991) name is octylacrylamide/acrylates/butylaminoethyl methacrylate copolymer, such as the products sold as AMPHOMER LV 71, Acrylates/octylacrylamide copolymer sold as Amphomer 28-4961 or LOVOCRYL 47 by National Starch, are particularly used.

[00334] The polycarboxylic acid compounds include Crosslinked and acylated polyaminoamides.

[00335] The polycarboxylic acid compounds include carboxylic acids selected from acids having 6 to 10 carbon atoms, such as adipic acid, 2,2,4-trimethyladipic acid and 2,4,4-trimethyladipic acid, terephthalic acid, acids containing an ethylenic double bond such as, for example, acrylic acid, methacrylic acid and itaconic acid.

[00336] The polycarboxylic acid compounds include Polymers comprising zwitterionic units of formula:

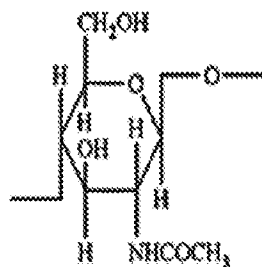


(II')

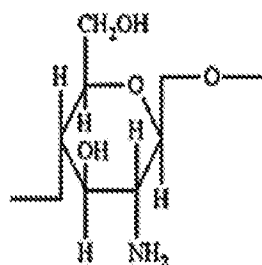
in which R11 denotes a polymerizable unsaturated group such as an acrylate, methacrylate, acrylamide or methacrylamide group, y and z represent an integer from 1 to 3, R12 and R13 represent a hydrogen atom, a methyl, ethyl or propyl group, R14 and R15 represent a hydrogen atom or an alkyl group such that the sum of the carbon atoms in R14 and R15 does not exceed 10.

[00337] The polymers comprising such units may also comprise units derived from non-zwitterionic monomers such as dimethyl- or diethylaminoethyl acrylate or methacrylate or alkyl acrylates or methacrylates, acrylamides or methacrylamides or vinyl acetate, for example, methyl methacrylate/methyl dimethylcarboxymethylammonioethyl methacrylate copolymers such sold as DIAFORMER Z301 by Sandoz; The polycarboxylic acid compounds include Polymers derived from chitosan comprising monomer units corresponding to the following formulae:

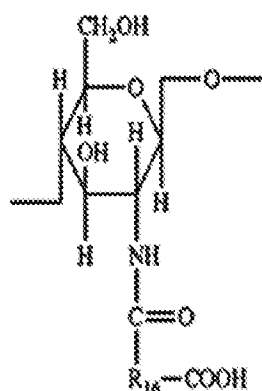
(D)



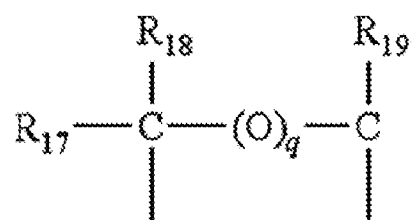
(E)



(F)



the unit (D) being present in proportions of between 0 and 30 percent, the unit (E) in proportions of between 5 percent and 50 percent and the unit (F) in proportions of between 30 percent and 90 percent, it being understood that, in this unit (F), R16 represents a group of formula:



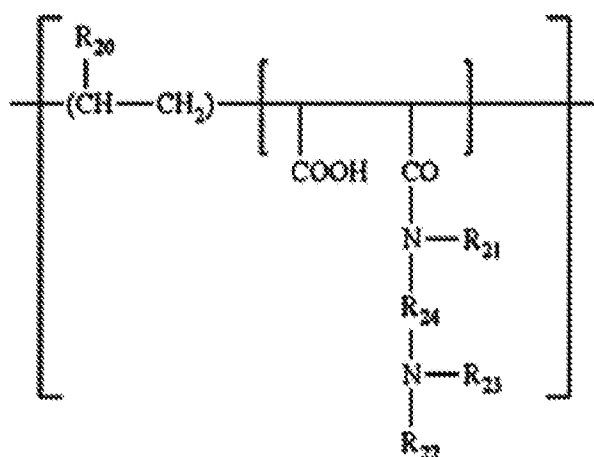
(III')

in which, if $q=0$, R17, R18 and R19, which may be identical or different, each represent a hydrogen atom, a methyl, hydroxyl, acetoxy or amino residue, a

monoalkylamine residue or a dialkylamine residue that are optionally interspersed with one or more nitrogen atoms and/or optionally substituted with one or more amine, hydroxyl, carboxyl, alkylthio or sulfonic groups, an alkylthio residue in which the alkyl group bears an amino residue, at least one of the groups R17, R18 and R19 being, in this case, a hydrogen atom;

or, if $q=1$, R17, R18 and R19 each represent a hydrogen atom, and also the salts formed by these compounds with bases or acids.

[00338] The polycarboxylic acid compounds include Polymers with units corresponding to the general formula below are described, for example, in French patent 1 400 366:



(IV')

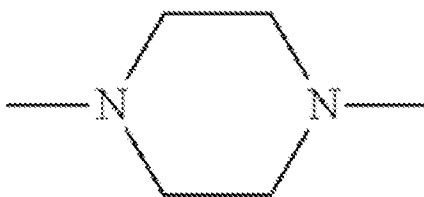
in which R20 represents a hydrogen atom, a CH₃O, CH₃CH₂O or phenyl group, R21 denotes a hydrogen atom or a lower alkyl group such as methyl or ethyl, R22 denotes a hydrogen atom or a C1-C6 lower alkyl group such as methyl or ethyl, R23 denotes a C1-C6 lower alkyl group such as methyl or ethyl or a group corresponding to the formula: -R₂₄-N(R₂₂)₂, R₂₄ representing a group -CH₂-CH₂-, -CH₂-CH₂-CH₂- or -CH₂-CH(CH₃)-, R₂₂ having the meanings mentioned above.

[00339] The polycarboxylic acid compounds include Polymers derived from the N-carboxyalkylation of chitosan, such as N-carboxymethylchitosan or N-carboxybutylchitosan.

[00340] The polycarboxylic acid compounds include Amphoteric polymers of the type -D-X-D-X selected from:

[00341] a) Polymers obtained by the action of chloroacetic acid or sodium chloroacetate on compounds comprising at least one unit of formula:

-D-X-D-X-D- (V') where D denotes a

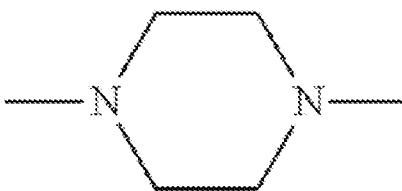


(VI')

group and X denotes the symbol E or E'; E or E' may be identical or different and denote a divalent group that is an alkylene group with a straight or branched chain containing up to 7 carbon atoms in the main chain, which is unsubstituted or substituted by hydroxyl groups and which may comprise, in addition to oxygen, nitrogen and sulfur atoms, 1 to 3 aromatic and/or heterocyclic rings; the oxygen, nitrogen and sulfur atoms being present in the form of ether, thioether, sulfoxide, sulfone, sulfonium, alkylamine or alkenylamine groups, hydroxyl, benzylamine, amine oxide, quaternary ammonium, amide, imide, alcohol, ester and/or urethane groups.

[00342] b) Polymers having the formula:

-D-X-D-X- (VI') where D denotes a



(VII')

group and X denotes the symbol E or E' and at least once E'; E having the meaning given above and E' is a divalent group that is an alkylene group with a straight or branched chain having up to 7 carbon atoms in the main chain, which is unsubstituted or substituted with one or more hydroxyl groups and containing one or more nitrogen atoms, the nitrogen atom being substituted with an alkyl chain that is optionally interspersed by an oxygen atom and necessarily comprising one or more

carboxyl functions or one or more hydroxyl functions and betainized by reaction with chloroacetic acid or sodium chloroacetate.

[00343] The polycarboxylic acid compounds include (C1-C5)Alkyl vinyl ether/maleic anhydride copolymers partially modified by semiamidation with an N,N-dialkylaminoalkylamine such as N,N-dimethylaminopropylamine or by semiesterification with an N,N-dialkylaminoalkanol. These copolymers may also comprise other vinyl comonomers such as vinylcaprolactam.

[00344] Among the amphoteric polymers described above, the ones that are most preferred are Octylacrylamide/acrylates/butylamino ethyl methacrylate copolymer, such as the products sold as AMPHOMER, AMPHOMER LV 71 or LOVOCRYL 47 by National Starch and the copolymers of methyl methacrylate/methyl dimethylcarboxy-methylammonioethyl methacrylate, sold, for example, as DIAFORMER Z301 by Sandoz.

[00345] The polycarboxylic acids of the present disclosure may be chosen from compounds which are known to be used as rheology modifiers or thickeners in cosmetic compositions. Such polymers include anionic and amphoteric polymers, for example crosslinked homopolymers of acrylic acid, associative polymers, non-associative thickening polymers, and water-soluble thickening polymers. Such polymers may also be chosen from nonionic, anionic, cationic and amphoteric amphiphilic polymers. The rheology modifiers or thickeners that can be used may include those polycarboxylic acid compounds described above.

[00346] The amphiphilic polymers may, optionally, contain a hydrophobic chain that is a saturated or unsaturated, aromatic or non-aromatic, linear or branched C6-C30 hydrocarbon-based chain, optionally comprising one or more oxyalkylene (oxyethylene and/or oxypropylene) units.

[00347] Representative examples of such amphiphilic polymers are:

nonionic amphiphilic polymers containing a hydrophobic chain such as:

copolymers of C1-C6 alkyl(meth)acrylates and of amphiphilic monomers containing a hydrophobic chain;

copolymers of hydrophilic (meth)acrylates and of hydrophobic monomers containing at least one hydrophobic chain, for instance the polyethylene glycol methacrylate/lauryl methacrylate copolymer;

anionic amphiphilic polymers containing at least one hydrophobic chain which are crosslinked or non-crosslinked, contain at least one hydrophilic unit derived from one or more ethylenically unsaturated monomers bearing a carboxylic acid function, which is free or partially or totally neutralized, and at least one hydrophobic unit derived from one or more ethylenically unsaturated monomers bearing a hydrophobic side chain, and optionally at least one crosslinking unit derived from one or more polyunsaturated monomers.

[00348] Examples of anionic amphiphilic polymers include CARBOPOL ETD-2020 (acrylic acid/C10-C30 alkyl methacrylate crosslinked copolymer sold by the company Noveon); CARBOPOL 1382, PEMULEN TR1 and PEMULEN TR2 (acrylic acid/C10-C30 alkyl acrylate crosslinked copolymers-sold by the company Noveon), the methacrylic acid/ethyl acrylate/oxyethylenated stearyl methacrylate copolymer (55/35/10); the (meth)acrylic acid/ethyl acrylate/25 EO oxyethylenated behenyl methacrylate copolymer (ACULYN 28 sold by Rohm and Haas) and the methacrylic acid/ethyl acrylate/steareth-10 allyl ether crosslinked copolymer.

[00349] Other examples include cross-linked acrylic polymers, for example those sold under the CARBOPOL SF series, such as ethyl acrylate / methacrylic acid copolymer with INCI name: acrylates copolymer, sold under the name CARBOPOL SF1(R) by the LUBRIZOL company.

[00350] Yet other examples include anionic polymers also known as anionic thickening polymers chosen from carbomers, acrylate copolymers, and crosslinked terpolymers of methacrylic acid, ethylacrylate, and polyethylene glycol (10 EO) stearyl alcohol ether (Steareth 10), such as the products sold by the company ALLIED COLLOIDS under the names SALCARE SC 80 and SALCARE SC 90, which are aqueous emulsions containing 30 percent of a crosslinked terpolymer of methacrylic acid, of ethyl acrylate and of steareth-10-allyl ether (40/50/10).

[00351] Anionic thickening polymers can also be chosen from:

terpolymers formed from maleic anhydride/C30-C38 alpha-olefin/alkyl maleate such as the product (maleic anhydride/C30-C38 alpha-olefin/isopropyl

maleate copolymer) sold under the name PERFORMA 1608 by the company NEWPHASE TECHNOLOGIES;

acrylic terpolymers formed from: (a) 20 percent to 70 percent by weight of a carboxylic acid with alpha, beta -monoethylenic unsaturation; (b) 20 percent to 80 percent by weight of a nonsurfactant monomer with alpha, beta -monoethylenic unsaturation different from (a); and (c) 0.5 percent to 60 percent by weight of a nonionic monourethane which is the product of the reaction of a monohydric surfactant with a monoisocyanate with monoethylenic unsaturation; (3) copolymers formed from at least two monomers, wherein at least one of the two monomers is chosen from a carboxylic acid with alpha, beta -monoethylenic unsaturation, an ester of a carboxylic acid with alpha, beta -monoethylenic unsaturation, and an oxyalkylenated fatty alcohol; and (4) copolymers formed from at least three monomers, wherein at least one of the three monomers is chosen from a carboxylic acid with alpha, beta -monoethylenic unsaturation, at least one of the three monomers is chosen from an ester of a carboxylic acid with alpha beta -monoethylenic unsaturation and at least one of the three monomers is chosen from an oxyalkylenated fatty alcohol.

[00352] Additionally, these compounds can also contain, as a monomer, a carboxylic acid ester comprising an apha, beta -monoethylenic unsaturation and a C1-C4 alcohol. By way of example of this type of compound, there may be mentioned ACULYN 22 sold by the company ROHM and HAAS, which is an oxyalkylenated stearyl methacrylate/ethylacrylate/methacrylic acid terpolymer.

[00353] The polycarboxylic acid compounds include associative polyurethanes, associative unsaturated polyacids, and associative polymers or copolymers containing at least one monomer comprising ethylenic unsaturation.

[00354] A representative example of an associative polyurethane is methacrylic acid/methyl acrylate/ethoxylated (40 EO) behenyl alcohol dimethyl(meta-isopropenyl)benzyl isocyanate terpolymer as a 25 percent aqueous dispersion, known by the trade name, VISCOPHOBE DB 1000 and commercially available from Amerchol.

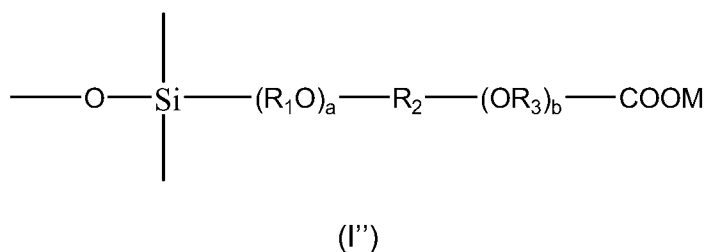
[00355] According to some embodiments of the present invention, the polycarboxylic acid compounds include at least one acrylic acid-based, (meth)acrylic

acid-based, acrylate-based or (meth)acrylate-based monomer having anionic and/or cationic functionalities. Suitable compounds include, but are not limited to, polymers comprising polyacrylates such as those identified in the International Cosmetic Ingredient Dictionary and Handbook (9th ed. 2002) such as, for example, polyacrylate-1, polyacrylate-2, polyacrylate-3, polyacrylate-4, polyacrylate-16, polyacrylate-17, polyacrylate-18, polyacrylate-19, polyacrylate-21, and mixtures thereof. Such (co)polymers, or similar (co)polymers, can be combined individually or with other (co)polymers in such a way to form suitable bimodal agents having both cationic and anionic functionalities. According to certain embodiments, the bimodal agent is selected from the group consisting of polymers consisting of polyacrylate-21 and acrylates/dimethylaminoethylmethacrylate copolymer (marketed under the name SYNTRAN PC 5100 by Interpolymer), polyacrylate-16 (marketed under the name SYNTRAN PC 5112 by Interpolymer), and polyacrylate-18 and polyacrylate-19 (marketed under the names SYNTRAN PC 5107 or SYNTRAN PC 5117 by Interpolymer).

[00356] Silicone Polymers Having At Least One Carboxylic Acid Group (Carboxysilicone Polymers).

[00357] The silicone polymers having at least one carboxylic acid group, referred herein as carboxysilicone polymers, according to the present disclosure, may be an organopolysiloxane comprising:

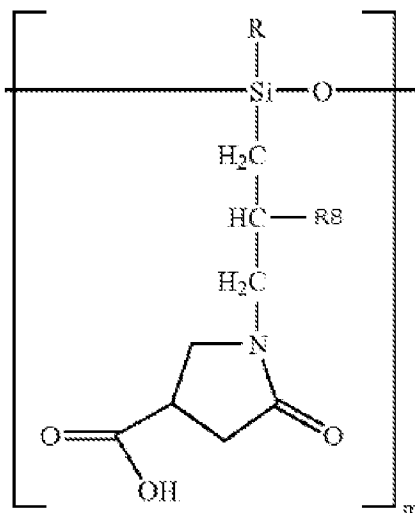
[00358] (A) a compound having the following formula:



wherein R₁ and R₃ independently denote a linear or branched alkylene radical containing from 2 to 20 carbon atoms and R₂ denotes a linear or branched alkylene radical containing from 1 to 50 carbon atoms which can comprise a hydroxyl group, a represents 0 or 1, b is a number ranging from 0 to 200 and M denotes hydrogen, an alkali metal or alkaline-earth metal, NH₄ or a quaternary ammonium group, such as

a mono-, di-, tri- or tetra(C1 -C4 alkylammonium) group, R_1 and R_3 can denote, for example, ethylene, propylene or butylene, or

[00359] (B) a group comprising at least one pyrrolidone carboxylic acid unit having the following formula:



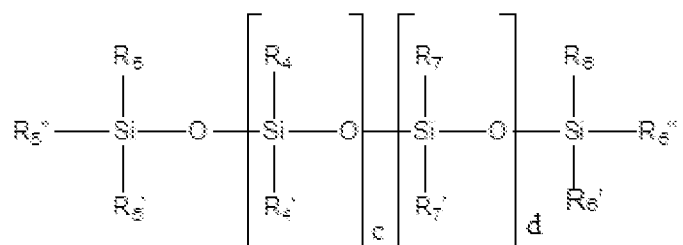
(II'')

in which R is selected from methyl or phenyl; R_8 is hydrogen or methyl, m is an integer from 1 to 1000, or

[00360] (C) a group comprising at least one polyvinyl acid/ester unit (C) resulting from the polymerization of Divinyl-PDMS, Crotonic Acid, Vinylacetate, and Vinyl Isoalkylester,

and combinations of (A), (B) and (C).

[00361] Suitable carboxysilicone polymers include, for example, a silicone polymer comprising at least one carboxylic acid group chosen from organopolysiloxanes of formula:



(III'')

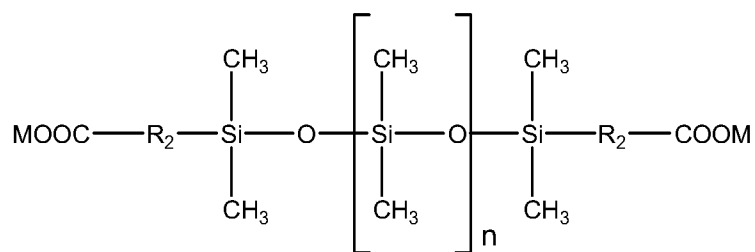
wherein the radicals R4, R4' are identical to or different from each other and are chosen from a linear or branched C1 -C22 alkyl radical, a C1 -C22 alkoxy radical and a phenyl radical, the radicals R5, R5', R5'', R6, R6', R6'', R7, and R7' are identical to or different from each other and are chosen from a linear or branched C1 -C22 alkyl radical, a C1 -C22 alkoxy radical, a phenyl radical, a radical $-(R1O)_a -R2-(OR3)_b -COOM$, a radical containing pyrrolidone carboxylic acid, a radical of polyvinyl acid/ester; and

wherein at least one of the radicals R5, R6 and R7 is a radical chosen from a radical $-(R1O)_a -R2-(OR3)_b -COOM$, a radical containing pyrrolidone carboxylic acid, a radical of polyvinyl acid/ester;

wherein R1, R2, R3, a, b and M have the same meaning as described in Unit (A) above;

wherein c and d are integers from 0 to 1000, the sum c+d in some particular embodiments ranging from 1 to 1000 or from 2 to 1000.

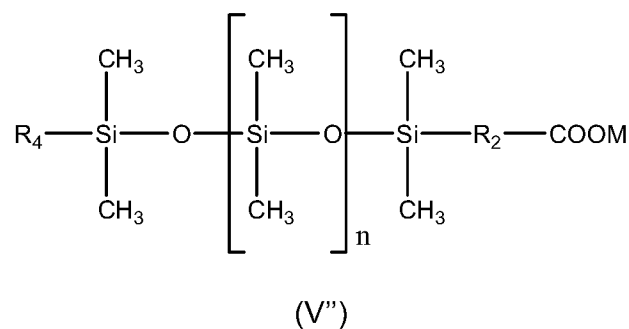
[00362] Among the carboxysilicone polymers of formula (III'') that comprise at least one unit (I''), which in some particular embodiments are the compounds of formula below:



(IV'')

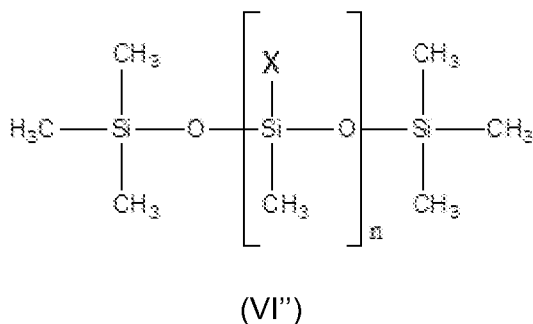
wherein R2, and M have the same meaning as described in Unit (A) above, n is an integer from 1 to 1000. Examples are: dual-end carboxy silicones X-22-162C from Shin Etsu and Silform INX (INCI name: Bis-Carboxydecyl Dimethicone) from Momentive.

[00363] Other exemplary embodiments organopolysiloxanes of formula (III'') are the ones of formula:



in which R₂, R₄, n, and M having the same meaning as in Unit (A) above. An example is a single-end carboxy silicone X-22-3710 from Shin Etsu.

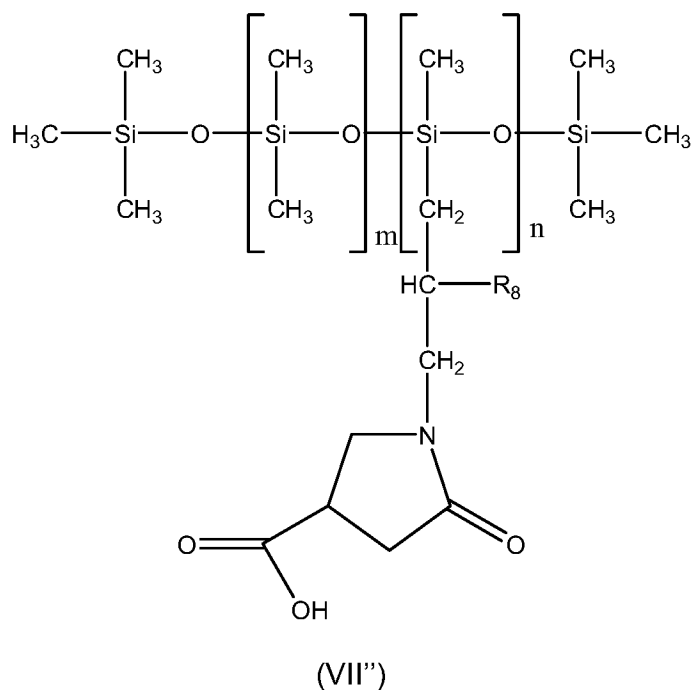
[00364] Other exemplary embodiments organopolysiloxanes of formula (III'') are the ones of formula:



wherein X is a radical $-(\text{R}_1\text{O})_a - \text{R}_2 - (\text{OR}_3)_b - \text{COOM}$ wherein R₁, R₂, R₃, a, b and M have the same meaning as described in Unit (A) above.

[00365] Even more particularly, the compounds of formula (VI') in which a and b are equal to 0 and R₂ is a linear or branched C₂-C₁₂ alkylene group such as (CH₂)₉, (CH₂)₁₀ or $-\text{CH}(\text{CH}_3)-$ are exemplary embodiments. An example is a side-chain carboxy silicone X-22-3701E from Shin Etsu.

[00366] Among the organopolysiloxanes of formula (III'') that contain unit (B), exemplary embodiments include the compounds of formula below:



wherein R₈, m, are defined as in Unit (B) above and n is an interger from 1 to 1000. An example is Grandsil PCA such as in Grandsil SiW-PCA-10 (INCI name: Dimethicone (and) PCA Dimethicone (and) Butylene Glycol (and) Decyl Glucoside from Grant Industries.

[00367] Among the organopolysiloxanes of formula (III'') that contain polyvinyl acid/ester Unit (C), exemplary embodiments are crosslinked anionic copolymers comprised of organic polymer blocks and silicone blocks, resulting in a multiblock polymer structure. In particular, the silicone-organic polymer compound of the present invention may be chosen from crosslinked anionic copolymers comprising at least one crosslinked polysiloxane structural unit. An example of such a branched multi-block carboxysilicone polymer is Belsil® P1101 (may also be known under the tradename Belsil® P1101) (INCI name: Crotonic Acid/Vinyl C8-12 Isoalkyl Esters/VA/Bis-Vinyldimethicone Crosspolymer, also known by the technical name of Crotonic Acid/Vinyl C8-12 Isoalkyl Esters/VA/divinyldimethicone Crosspolymer) from Wacker Chemie AG.

[00368] Additional suitable carboxysilicone polymers are described, for example, in patent applications WO 95/23579 and EP-A-0,219,830, which are hereby incorporated by reference in their entirety.

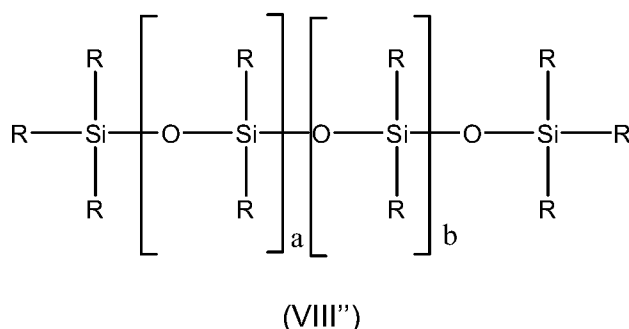
[00369] Compounds corresponding to formula (VI'') above are sold, for example, under the name HUILE M 642 by the company Wacker, under the names SLM 23 000/1 and SLM 23 000/2 by the company Wacker, under the name 176-12057 by the company General Electric, under the name FZ 3703 by the company OSI and under the name BY 16 880 by the company Toray Silicone.

[00370] Other non-limiting examples of carboxysilicone polymers are silicone carboxylate containing polymers (silicone carboxylates).

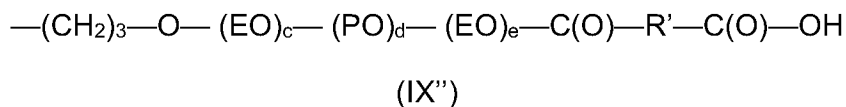
[00371] Suitable silicone carboxylates may be chosen from water soluble silicone compounds comprising at least one carboxylic acid group, oil soluble silicone compounds comprising at least one carboxylic acid group, water-dispersible silicone compounds comprising at least one carboxylic acid group, and silicone compounds comprising at least one carboxylic acid group which are soluble in organic solvents. In one embodiment, the silicone carboxylate further comprises at least one alkoxyated chain, wherein the at least one alkoxy group may be chosen from terminal alkoxy groups, pendant alkoxy groups, and alkoxy groups which are intercalated in the skeleton of the at least one silicone compound. Non-limiting examples of at least one alkoxy group include ethylene oxide groups and propylene oxide groups.

[00372] The at least one carboxylic acid group may be chosen from terminal carboxylic acid groups and pendant carboxylic acid groups. Further, the at least one carboxylic acid may be chosen from carboxylic acid groups in free acid form, i.e., -COOH, and carboxylic acid groups in salt form, i.e., -COOM, wherein M may be chosen from inorganic cations, such as, for example, potassium cations and sodium cations, and organic cations.

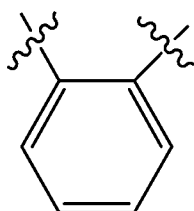
[00373] In one embodiment, the silicone carboxylate is a compound of formula:



wherein a is an integer ranging from 1 to 100; b is an integer ranging from 0 to 500; and R, which may be identical or different, are each chosen from optionally substituted hydrocarbon groups comprising from 1 to 9 carbon atoms, optionally substituted phenyl groups, and groups of the following formula:

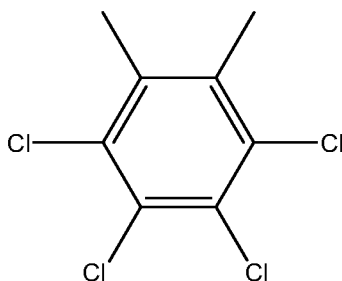


wherein c, d, and e, which may be identical or different, are each integers ranging from 0 to 20; EO is an ethylene oxide group; PO is a propylene oxide group; and R' is chosen from optionally substituted divalent hydrocarbons, such as alkylene groups and alkenylene groups comprising from 2 to 22 carbon atoms, and optionally substituted divalent aromatic groups, such as groups of the following formula (X''):



(X'')

and groups of the following formula (XI''):

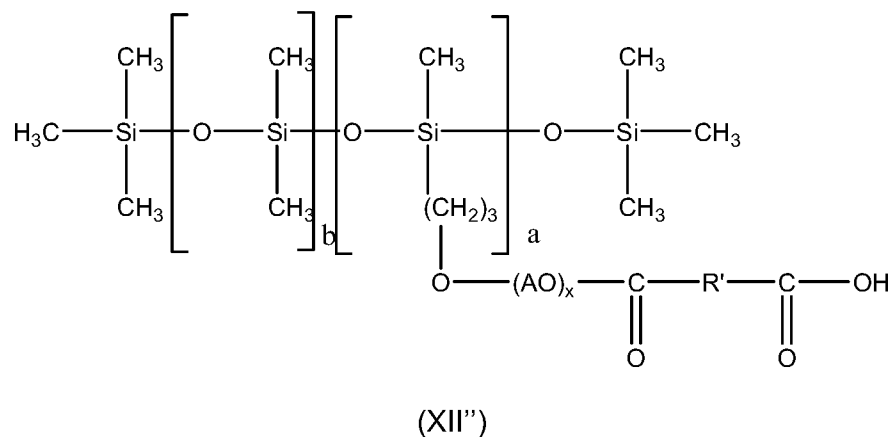


(XI'')

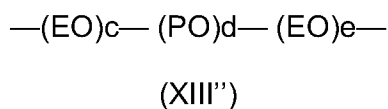
with the proviso that at least one of the R groups is chosen from groups of formula (VIII'') and with the further proviso that when only one of the R groups is chosen from groups of formula (VII''), the other R groups are not all methyl groups.

[00374] Non-limiting examples of silicone carboxylates include those commercially available from Noveon under the name Ultrasil® CA-1 Silicone (Dimethicone PEG-7 Phthalate) and Ultrasil® CA-2 Silicone (Dimethicone PEG-7 Succinate), both of which

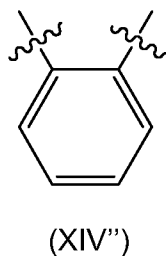
correspond to formula (XII'') below. Thus, in one embodiment, the at least one silicone carboxylate is chosen from a compound of formula below and salts thereof:



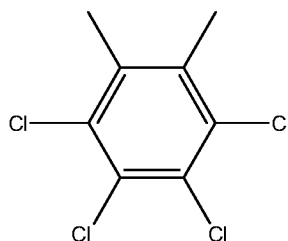
wherein a is an integer ranging from 1 to 100, b is an integer ranging from 0 to 500, AO is chosen from groups of the following formula (XIII''):



wherein c, d, and e, which may be identical or different, are each integers ranging from 0 to 20; EO is an ethylene oxide group; PO is a propylene oxide group; x is an integer ranging from 0 to 60; R' is chosen from optionally substituted divalent hydrocarbons, such as alkylene groups and alkenylene groups comprising from 2 to 22 carbon atoms, and optionally substituted divalent aromatic groups, such as groups of the following formula (XIV''):



and groups of formula (XV''):



(XV")

[00375] Non-limiting examples of silicone carboxylates include those described in U.S. Pat. Nos. 5,248,783 and 5,739,371, the disclosures of which are incorporated herein by reference, and which are silicone compounds of formula (VIII").

[00376] Cationic polymers containing At Least One Carboxyl Group.

[00377] The cationic polymer can have a negative charge but remains cationic overall, can be an amphoteric polymer that can carry a cationic charge based on pH, or can be a betaine polymer that remains amphoteric at any pH.

[00378] The cationic polymers are polymers that result from the homopolymerization or copolymerization of ethylenically unsaturated monomers chosen from: (i) at least one nonionic monomer such as (Alkyl)(Meth)Acrylamide, (Alkyl)(Meth)Acrylate Ester, Vinyl Pyrrolidone, Vinyl Imidazole; (ii) at least one cationic monomer such as Ethyltrimonium (Alkyl)(Meth)Acrylamide, Ethyltrimonium (Alkyl)(Meth)Acrylate Ester, Vinylimidazoline, Dimethylaminopropyl (Alkyl)(Meth)Acrylamide, Methacrylamidopropyl Triethyl Ammonium Chloride (MAPTAC), Diallyl Dimethyl Ammonium Chloride (DADMAC); (iii) at least one (Alkyl)Acrylic acid; (iv) at least one amphoteric monomer such as a carboxybetaine zwitterionic monomer.

[00379] Suitable examples of such cationic polymers are: the diallyldimethylammonium chloride/acrylic acid copolymers sold under the names MERQUAT 280 POLYMER or MERQUAT 280NP POLYMER or MERQUAT 281 POLYMER or MERQUAT 295 POLYMER, by the company Nalco (Lubrizol) (INCI name: Polyquaternium-22); the copolymer of methacrylamidopropyltrimonium chloride, of acrylic acid and or methyl acrylate, sold under the name MERQUAT 2001 POLYMER OR MERQUAT 2001N POLYMER by the company Nalco (Lubrizol) (INCI name: Polyquaternium-47); the acrylamide/dimethyldiallylammonium chloride/acrylic acid terpolymer sold under the name MERQUAT 3330DRY POLYMER or MERQUAT 3330PR POLYMER or MERQUAT 3331PR POLYMER or MERQUAT 3940 POLYMER or MERQUAT PLUS 3330 POLYMER OR MERQUAT PLUS 3331 POLYMER by the company Nalco (Lubrizol) (INCI name: Polyquaternium-39); an ampholytic terpolymer consisting of methacrylamidopropyl trimethyl ammonium chloride (MAPTAC), acrylamide and acrylic acid, sold under the

name MERQUAT 2003PR POLYMER by the company Nalco (Lubrizol) (INCI name: Polyquaternium-53); Polyquaternium-30, Polyquaternium-35, Polyquaternium-45, Polyquaternium-50, Polyquaternium-54; Polyquaternium-57; Polyquaternium-63; Polyquaternium-74; Polyquaternium-76; Polyquaternium-86; Polyquaternium-89; Polyquaternium-95; Polyquaternium-98, Polyquaternium-104; Polyquaternium-111; Polyquaternium-112, and mixtures thereof.

[00380] LATEX POLYMERS

[00381] According to various exemplary embodiments, the compositions of the present invention can further comprise one or more latex polymers (also referred to as "latex polymers" in this application) can be chosen from carboxyl functional acrylate latex polymers, carboxyl functional polyurethane latex polymers, carboxyl functional silicone latex polymers, carboxyl functional non-acrylate latex polymers and mixtures thereof.

[00382] In various embodiments, the latex polymers of the present invention can be film-forming latex polymers or non film-forming latex polymers.

[00383] In at least certain embodiments of the disclosure, the latex polymers are provided in the form of aqueous dispersions prior to formulating the compositions of the disclosure. In various embodiments, the aqueous dispersions may be obtained through an emulsion polymerization of monomers wherein the resulting latex polymers have a particle size lower than about 1 micron. In at least one exemplary embodiment, a dispersion prepared by the polymerization in water of one or more monomers having a polymerizable double bond may be chosen. In another exemplary embodiment, the aqueous dispersions obtained through an emulsion polymerization may be spray-dried.

[00384] In other embodiments, the latex polymers are produced from condensation reactions between monomers and subsequently dispersed in an aqueous medium.

[00385] Thus, the latex polymers may, in various exemplary embodiments, exist as dispersed polymer particles in a dispersion medium, such as an aqueous dispersion medium. The latex polymers may, in various embodiments, each be dispersed in independent dispersion media or dispersed together in the same dispersion medium.

[00386] The dispersion medium comprises at least one solvent chosen from water. The dispersion medium may further comprise at least one solvent chosen from cosmetically acceptable organic solvents such as those described above.

[00387] In embodiments according to the disclosure, the latex polymer particles are not soluble in the solvent of the dispersion medium, i.e. are not water soluble and/or are not soluble in the at least one cosmetically acceptable organic solvent. Accordingly, the latex polymers retain their particulate form in the solvent or solvents chosen.

[00388] In at least certain exemplary embodiments, latex polymer particles according to the disclosure may have an average diameter ranging up to about 1000 nm, such as from about 50 nm to about 800 nm, or from about 100 nm to about 500 nm. Such particle sizes may be measured with a laser granulometer (e.g. Brookhaven BI90).

[00389] In various embodiments, the latex polymers may, independently, be neutralized, partially neutralized, or unneutralized. In exemplary embodiments where the latex polymers are neutralized or partially neutralized, the particle size may be, for example, greater than about 800 nm. In at least certain embodiments, the particulate form of the latex polymers is retained in the dispersion medium.

[00390] In further embodiments, the latex polymers may be chosen from uncharged and charged latex polymers. Thus, the latex polymers may, according to various exemplary embodiments, be chosen from nonionic latex polymers, cationic latex polymers, anionic latex polymers and amphoteric latex polymers.

[00391] By way of non-limiting example only, the latex polymers may be chosen from carboxyl functional acrylate latex polymers, such as those resulting from the homopolymerization or copolymerization of ethylenically unsaturated monomers chosen from vinyl monomers, (meth)acrylic monomers, (meth)acrylamide monomers, mono- and dicarboxylic unsaturated acids, esters of (meth)acrylic monomers, and amides of (meth)acrylic monomers. The term “(meth)acryl” and variations thereof, as used herein, means acryl or methacryl.

[00392] The (meth)acrylic monomers may be chosen from, for example, acrylic acid, methacrylic acid, citraconic acid, itaconic acid, maleic acid, fumaric acid, crotonic acid, and maleic anhydride. The esters of (meth)acrylic monomers may be,

by way of non-limiting example, C1-C8 alkyl (meth)acrylates such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, butyl (meth)acrylate, tert-butyl (meth)acrylate, pentyl(meth) acrylate, isopentyl (meth)acrylate, neopentyl (meth)acrylate, hexyl (meth)acrylate, isohexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, cyclohexyl (meth)acrylate, isohexyl (meth)acrylate, heptyl (meth)acrylate, isoheptyl (meth)acrylate, octyl (meth)acrylate, isooctyl (meth)acrylate, allyl (meth)acrylate, and combinations thereof. The amides of (meth)acrylic monomers can, for example, be made of (meth)acrylamides, and especially N-alkyl (meth)acrylamides, in particular N-(C1-C12) alkyl (meth)acrylates such as N-ethyl (meth)acrylamide, N-t-butyl (meth)acrylamide, N-t-octyl (meth)acrylamide, N-methylol (meth)acrylamide and N-diacetone (meth)acrylamide, and any combination thereof.

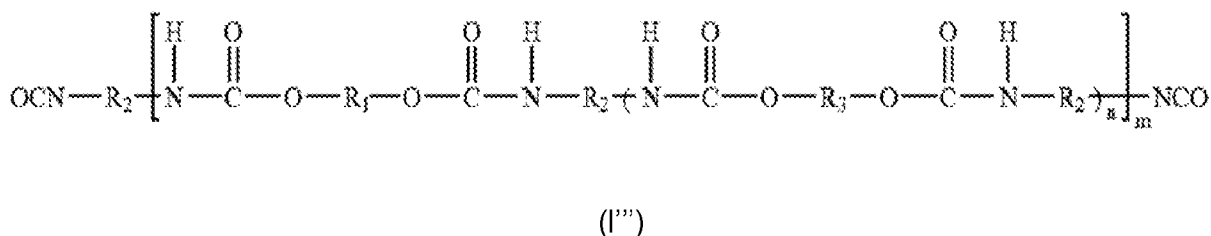
[00393] The vinyl monomers can include, but are not limited to, vinyl cyanide compounds such as acrylonitrile and methacrylonitrile; vinyl esters such as vinyl formate, vinyl acetate, vinyl propionate, vinyl neodecanoate, vinyl pivalate, vinyl benzoate and vinyl t-butyl benzoate, triallyl cyanurate; vinyl halides such as vinyl chloride and vinylidene chloride; aromatic mono- or divinyl compounds such as styrene, α -methylstyrene, chlorostyrene, alkylstyrene, divinylbenzene and diallyl phthalate, as well as para-styrenesulfonic, vinylsulfonic, 2-(meth)acryloyloxyethylsulfonic, 2-(meth)acrylamido-2-methylpropylsulfonic acids, and mixtures thereof.

[00394] The list of monomers given is not limiting, and it should be understood that it is possible to use any monomer known to those skilled in the art which includes acrylic and/or vinyl monomers (including monomers modified with a silicone chain).

[00395] In at least certain, non-limiting exemplary embodiments carboxyl functional acrylate latex polymers may be chosen from aqueous dispersions of Methacrylic Acid/Ethyl Acrylate copolymer (INCI: Acrylates Copolymer, such as Luviflex® SOFT by BASF), PEG/PPG-23/6 Dimethicone Citraconate/C10-30 Alkyl PEG-25 Methacrylate/Acrylic Acid/Methacrylic Acid/Ethyl Acrylate/Trimethylolpropane PEG-15 Triacrylate copolymer (INCI: Polyacrylate-2 Crosspolymer, such as Fixate Superhold™ by Lubrizol), Styrene/Acrylic copolymer (such as Acudyne Shine by Dow Chemical), Ethylhexyl Acrylate/Methyl Methacrylate/Butyl Acrylate/Acrylic Acid/Methacrylic Acid copolymer (INCI: Acrylates/Ethylhexyl Acrylate Copolymer, such as

Daitosol 5000SJ, Daito Kasei Kogyo), Acrylic/Acrylates Copolymer (INCI name: Acrylates Copolymer, such as Daitosol 5000AD, Daito Kasei Kogyo), Acrylates Copolymers, such as those known under the tradename Dermacryl AQF (Akzo Nobel), under the tradename LUVIMER® MAE (BASF), or under the tradename BALANCE CR (AKZO NOBEL), Acrylates/Hydroxyesters Acrylates Copolymer, known under the tradename ACUDYNE 180 POLYMER (Dow Chemical), Styrene/Acrylates Copolymer, known under the tradename Acudyne Bold from Dow Chemical, Styrene/Acrylates/Ammonium Methacrylate Copolymer, known under the tradename SYNTRAN PC5620 CG from Interpolymer, and mixtures thereof.

[00396] In yet further exemplary and non-limiting embodiments, the latex polymers may be chosen from carboxyl functional polyurethane latex polymers, such as aqueous polyurethane dispersions. These polyurethanes are conventionally formed by the reaction of prepolymer (i) with a coreactant (ii) to produce a carboxyl terminated or pendant polyurethane polymer. The prepolymer (i) may have the structure according to the formula (I'''):



wherein R1 is chosen from bivalent radicals of a dihydroxyl functional compound, R2 is chosen from hydrocarbon radicals of an aliphatic or cycloaliphatic polyisocyanate, and R3 is chosen from radicals of a low molecular weight diol, optionally substituted with ionic groups or potential ionic groups, n ranges from about 0 to about 5, and m is greater than about 1.

[00397] Suitable dihydroxyl compounds for providing the bivalent radical R1 include those having at least two hydroxy groups, and having number average molecular weights ranging from about 700 to about 16,000, such as, for example, from about 750 to about 5000. Non-limiting examples of the high molecular weight compounds include polyester polyols, polyether polyols, polyhydroxy polycarbonates, polyhydroxy polyacetals, polyhydroxy polyacrylates, polyhydroxy polyester amides, polyhydroxy polyalkadienes and polyhydroxy polythioethers. In

various embodiments, polyester polyols, polyether polyols, and polyhydroxy polycarbonates may be chosen. Mixtures of such compounds are also within the scope of the disclosure.

[00398] Optional polyisocyanates for providing the hydrocarbon-based radical R2 include, for example, organic diisocyanates having a molecular weight ranging from about 100 to about 1500, such as about 112 to about 1000, or about 140 to about 400.

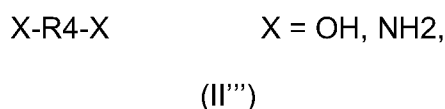
[00399] Optional diisocyanates are those chosen from the general formula $R_2(NCO)_2$, in which R2 represents a divalent aliphatic hydrocarbon group comprising from about 4 to 18 carbon atoms, a divalent cycloaliphatic hydrocarbon group comprising from about 5 to 15 carbon atoms, a divalent aromatic hydrocarbon group comprising from about 7 to 15 carbon atoms, or a divalent aromatic hydrocarbon group comprising from about 6 to 15 carbon atoms.

[00400] The use of diols, for example low molecular weight diols, R3, may in at least certain embodiments allow a stiffening of the polymer chain. The expression "low molecular weight diols" means diols having a molecular weight ranging from about 50 to about 800, such as about 60 to 700, or about 62 to 200. They may, in various embodiments, contain aliphatic, alicyclic, or aromatic groups. In certain exemplary embodiments, the compounds contain only aliphatic groups. The diols that may be chosen may optionally have up to about 20 carbon atoms, and may be chosen, for example, from ethylene glycol, diethylene glycol, propane-1,2-diol, propane-1,3-diol, butane-1,4-diol, 1,3-butylene glycol, neopentyl glycol, butylethylpropanediol, cyclohexanediol, 1,4-cyclohexanedimethanol, hexane-1,6-diol, bisphenol A (2,2-bis(4-hydroxyphenyl)propane), hydrogenated bisphenol A (2,2-bis(4-hydroxycyclohexyl)propane), and mixtures thereof. For example, R3 may be derived from neopentyl glycol.

[00401] Optionally, the low molecular weight diols may contain ionic or potentially ionic groups. Suitable low molecular weight diols containing ionic or potentially ionic groups may be chosen from those disclosed in U.S. Patent No. 3,412,054. In various embodiments, compounds may be chosen from dimethylolbutanoic acid (DMBA), dimethylolpropionic acid (DMPA), and carboxyl-containing caprolactone polyester diol. If low molecular weight diols containing ionic or potentially ionic groups are

chosen, they may, for example, be used in an amount such that less than about 0.30 meq of -COOH is present per gram of polyurethane in the polyurethane dispersion. In at least certain exemplary and non-limiting embodiments, the low molecular weight diols containing ionic or potentially ionic groups are not used.

[00402] Coreactants (ii) are compounds containing functional groups such as hydroxy or amine groups, in certain embodiments a primary amine, adapted to react with isocyanate groups in preference to the carboxyl group according to the formula (II'''):



wherein R₄ represents a divalent aliphatic or cycloaliphatic or aromatic hydrocarbon group, optionally substituted with ionic groups or potentially ionic groups. In various embodiments, compounds may optionally be chosen from alkylene diamines, such as hydrazine, ethylenediamine, propylenediamine, 1,4-butylenediamine and piperazine; In various embodiments, compounds may optionally be chosen from alkylene diols, such as ethylene glycol, 1,4-butanediol (1,4-BDO or BDO), 1,6-hexanediol.

[00403] As used herein, ionic or potentially ionic groups may include groups comprising ternary or quaternary ammonium groups, groups convertible into such groups, carboxyl groups, carboxylate groups, sulphonic acid groups, and sulphonate groups. At least partial conversion of the groups convertible into salt groups of the type mentioned may take place before or during the mixing with water. Special compounds may be chosen from dimethylolbutanoic acid (DMBA), dimethylolpropionic acid (DMPA), or carboxyl functional polyester comprising excess equivalents of dicarboxylic acid reacted with lesser equivalents of glycol or carboxyl-containing caprolactone polyester diol.

[00404] R₁, R₂, R₃, R₄ can have at least one carboxyl group independently.

[00405] By way of non-limiting example, such latexes include, but are not limited to, aqueous polyurethane dispersion of Isophthalic Acid/Adipic Acid/Hexylene Glycol/Neopentyl glycol/Dimethylolpropanoic Acid/Isophorone Diisocyanate copolymer (INCI name: Polyurethane-1, such as Luviset® P.U.R, BASF), a copolymer of hexylene glycol, neopentyl glycol, adipic acid, saturated methylene

diphenyldiisocyanate and dimethylolpropanoic acid monomers (INCI name: polyurethane 2), a copolymer of PPG-17, PPG-34, isophorone diisocyanate and dimethylolpropanoic acid monomers (INCI name: polyurethane 4), a copolymer of isophthalic acid, adipic acid, hexylene glycol, neopentyl glycol, dimethylolpropanoic acid, isophorone diisocyanate and bis-ethylaminoisobutyl-dimethicone monomers (INCI name: polyurethane 6), Isophorone diisocyanate, cyclohexanedimethanol, dimethylol butanoic acid, polyalkylene glycol and N-methyl diethanolamine copolymer (INCI name: polyurethane 10), Trimethylolpropane, neopentyl glycol, dimethylol propionic acid, polytetramethylene ether glycol and isocyanato methylethylbenzene copolymer (INCI name: polyurethane 12), Isophorone diisocyanate, dimethylol propionic acid, and 4,4'-isopropylidenediphenol reacted with propylene oxide, ethylene oxide and PEG/PPG-17/3 copolymer (INCI name: polyurethane 14), Isophorone diisocyanate, adipic acid, triethylene glycol and dimethylolpropionic acid copolymer (INCI name: polyurethane 15), 2-Methyl-2,4-pentanediol, polymer with 2,2-dimethyl-1,3-propanediol, hexanedioic acid, methylenedicyclohexanediisocyanate and 2,2-di(hydroxymethyl)propanoic acid, hydrolysed, tris(2-hydroxyethyl)amine salts, reaction products with 1,2-ethanediamine (INCI name: polyurethane 17), Polyurethane-27 is a complex polymer that is formed by the reaction of Polyperfluoroethoxymethoxy Difluorohydroxyethyl Ether and isophorone diisocyanate (IPDI) to form a prepolymer. The prepolymer is further reacted with the triethylamine salt of 3-hydroxy-2-(hydroxymethyl)-2-methyl-1-propionic acid (INCI name: polyurethane 27), a complex polymer formed by reacting dimethylolpropionic acid and a polyester composed of Adipic Acid, Hexylene Glycol, Neopentyl Glycol with methylene dicyclohexyldiisocyanate (SMDI) to form a prepolymer. The prepolymer is neutralized with triethylamine and then chain-extended with hydrazine (INCI name: polyurethane 33).

[00406] Carboxylic acid compound chosen from fatty acids, their salts, and mixtures thereof.

[00407] The carboxylic acid compound may generally be chosen from saturated or unsaturated carboxylic acids having carbon chains containing from 6 to 30 carbon atoms, in certain embodiments from 9 to 30 carbon atoms, and in certain embodiments from 9 to 22 carbon atoms and wherein the carbon chain is optionally substituted, for example with one or more (in particular 1 to 4) hydroxyl groups. If the

fatty acids of the present disclosure are unsaturated, these compounds may comprise one to three conjugated or unconjugated carbon-carbon double bonds.

[00408] Suitable examples of the carboxylic acid compound of the present disclosure are oleic acid, linoleic acid, linolenic acid, isostearic acid, caproic acid, capric acid, caprylic acid, oleic acid, linoleic acid, linolenic acid, behenic acid, lauric acid, myristic acid, stearic acid, palmitic acid and mixtures thereof.

[00409] The carboxylic acid compound of the present disclosure may also be chosen from salts of fatty acids, in particular, alkali metal salts of fatty acids (metal soaps) and organic base salts of fatty acids.

[00410] The metal of the alkali metal salts of fatty acids includes sodium, potassium, lithium and their mixtures. The organic base salts of fatty acids may be obtained from the neutralization of fatty acids with organic bases such as ammonia, monoethanolamine or triethanolamine. Suitable examples include sodium stearate, zinc laurate, magnesium stearate, magnesium myristate, zinc stearate, potassium cocoate ammonium stearate, ammonium oleate, ammonium nonanoate, and their mixtures.

[00411] If present in the composition, the above-described additives are generally present in an amount ranging up to about 95% by weight including all ranges and subranges therebetween, based on the total weight of the composition, such as up to about 50%, up to about 40%, up to about 30%, up to about 20%, up to about 15%, up to about 10%, up to about 5%, such as from about 0.001% to about 50%, or from about 0.001% to about 40%, or from about 0.001% to about 30%, or from about 0.001% to about 20%, or from about 0.001% to about 10%, by weight, based on the total weight of the composition.

[00412] Needless to say, a person skilled in the art will take care to select this or these optional additional compound(s), and/or the amount thereof, such that the advantageous properties of the composition, according to the invention, are not, or are not substantially, adversely affected by the envisaged addition.

[00413] METHODS OF PREPARATION AND METHODS OF USE

[00414] In some embodiments, the compositions of the present disclosure are prepared by combining the polycarbodiimide, one or more of a compound chosen

from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, and a solvent.

[00415] In other embodiments, the compositions of the present disclosure are prepared by combining the polycarbodiimide, one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, and a solvent chosen from water, organic solvents, and mixtures thereof.

[00416] In yet other embodiments, the compositions of the present disclosure are prepared by combining the polycarbodiimide, one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, and a solvent comprising water and organic solvents.

[00417] METHODS: Preparation and Use with Colorants/Dyes

[00418] In some embodiments, the compositions of the present disclosure are prepared by combining polycarbodiimide, optional colorant or dye, and amino compound chosen from polyamines and silicone amines, and a solvent.

[00419] In other embodiments, the compositions of the present disclosure are prepared by combining the polycarbodiimide, optional colorant or dye, amino compound chosen from polyamines and silicone amines, and a solvent chosen from water, organic solvents, and mixtures thereof.

[00420] In yet other embodiments, the compositions of the present disclosure are prepared by combining the polycarbodiimide, optional colorant or dye, amino compound chosen from polyamines and silicone amines, and a solvent comprising water and organic solvents.

[00421] ONE-STEP APPLICATION PROCESS

[00422] In one embodiment, the composition of the present disclosure is applied onto keratinous substrates such as hair in a one-step application process. The composition for use in the one-step application is prepared by combining the ingredients, including the polycarbodiimide, amino silicone, and solvent, resulting in a composition that is then applied onto the keratinous substrate.

[00423] In one embodiment, when the composition for a one-step application process comprises a solvent comprising water and an organic solvent, the polycarbodiimide is combined with water to form an aqueous phase and the amino silicone is combined with an organic solvent to form a non-aqueous phase. Both phases are then combined and agitated to form an emulsion. The formed emulsion is then applied to a keratinous substrate such as hair for treatment.

[00424] In another embodiment, the polycarbodiimide and amino silicone are combined with water to form an aqueous composition which is applied to a keratinous substrate such as hair for treatment.

[00425] TWO-STEP APPLICATION PROCESS

[00426] In other embodiments, the composition of the present disclosure is applied onto keratinous substrates such as hair in a two-step application process. In a two-step application process, the individual components (polycarbodiimide combined with a solvent and amino silicone combined with a solvent) are applied to the keratinous substrate in a step-wise fashion in any order to treat the substrate.

[00427] The application of the composition onto a keratinous substrate such as hair, according to the present disclosure, may occur at room temperature.

[00428] In other embodiments, the application of the composition according to the present disclosure, may occur at an elevated temperature (or temperatures greater than room temperature) by applying heat to the hair or exposing hair to elevated temperatures. While not so limited, heating may be provided, for example, by commonly used heating tools for example a helmet dryer or blow dryer (40° C and above) or hot iron or flat iron (120° C- 250° C) or steam/hot rollers.

[00429] The composition and treatment, according to the present disclosure, provides advantageous properties to keratinous fibers. In one embodiment, the composition and treatment, according to the present disclosure, provides hydrophobicity or imparts hydrophobicity to hydrophilic or damaged keratinous fibers, such as damaged hair (platinum bleached), upon application thereto. In certain embodiments, hydrophobicity is provided at room temperature, i.e., without heating or applying heat to the hair. In other embodiments, the hydrophobicity is provided when heat is used on the hair (before or after applying the composition on the hair or during the application of the composition on the hair). In one embodiment, the

hydrophobicity provided to less hydrophobic or hydrophilic keratinous fibers includes a contact angle of greater than 80° or greater than 90° or greater than 100° or greater than 110°. In yet other embodiments, the hydrophobicity is provided when heat is used on the hair (before or after applying the composition on the hair or during the application of the composition on the hair). In one embodiment, the hydrophobicity provided to less hydrophobic or hydrophilic keratinous fibers includes a contact angle of greater than 70° or greater than 80° or greater than 90°, or greater than 100° or greater than 110°, or greater than 120°, or ranging from between about 70° and about 120°, such as from between about 90° and about 120°, or such as from between about 100° and about 120°.

[00430] For example, hair treated with the inventive compositions, when heated at 50° C for 30 minutes and then allowed to cool down for a period of time at room temperature, exhibited increased percent curl retention indicating higher resistance to high humidity and high temperature compared to hair treated with either material alone. With the use of heat (drying in the oven), the percent curl retained using the inventive composition was greater than that obtained when heat was not applied or employed on hair. Accordingly, the composition, according to the present disclosure, provides increased curling benefits when utilized, particularly when the keratinous fibers are exposed to commonly used heating tools, such as a blow dryer (60° C) or hot iron or flat iron (120° C- 250° C) or a heat lamp, a heat wand, or other similar devices.

[00431] The method or process of using the compositions of the present invention may depend on the type of hair being targeted and, consequently, on the specific ingredients contained in the composition used to style or shape or maintain the shape of hair.

[00432] An embodiment of the present invention is a method of styling or shaping or maintaining the shape of hair.

[00433] Another embodiment of the present invention is a method of imparting durable or long-lasting style or shape to hair comprising applying onto the hair, any one of the compositions of the present disclosure.

[00434] According to at least one embodiment, such a method comprises applying to the hair, an effective amount of any one of the compositions of the present disclosure.

[00435] The compositions of the present disclosure may be employed in an effective amount to adequately cover the surface of the fibers of the hair and to achieve a desirable or effective style or shape of the hair as well as a desirable degree of hold. The precise amount of composition to be applied onto the hair will thus depend on the degree of treatment/styling/shaping/hold desired.

[00436] An effective amount of the composition is typically from about 0.1 gram to about 50 grams, and in some applications for treatment of hair, in amounts from about 20 to 60 grams, and in yet further embodiments for an abundance of hair in amounts from about 20 to about 80 grams or more. It will thus be appreciated that the amounts applied depend on the amount or volume of keratinous material, such as hair, to be treated and may thus fall within lower ranges for small amounts or patches of hair to the higher ranges and beyond for large amounts or patches of hair. Typical applications are to the whole head in the case of treatment of hair. It will be understood that application to the hair typically includes working the composition through the hair.

[00437] Further disclosed herein is the use of the compositions of the present disclosure for shaping or styling hair and/or retaining a hairstyle. Also disclosed is the use of the compositions of the present disclosure for caring for the hair such as for hair repair treatments, or for reducing damage to the hair or for improving the feel of the hair by imparting hydrophobicity to the hair.

[00438] The compositions may be applied to wet or dry hair, before or after shaping. They may be used in a non-rinse fashion. In some other embodiments, the composition may be rinsed from the hair.

[00439] The hair that has been contacted with the compositions of the present invention may be air-dried and/or further styled or shaped by applying heat on the hair and/or by combing or brushing or running the fingers through the hair. Other shaping tools may be chosen from combs and brushes.

[00440] In certain embodiments, the composition is allowed to remain (leave-on time) on the keratin fibers, for example, from about 1 to about 60 minutes, or such as

from about 5 to about 45 minutes, or such as from about 5 to about 30 minutes, or such as from about 10 to about 20 minutes, or such as at about 20 minutes, or such as at about 10 minutes.

[00441] The smoothing action may be accomplished by use of suitable devices for brushing or smoothing the hair include a hair brush, comb, or flat iron. The smoothing action on the hair may also include running the fingers through the hair.

[00442] A suitable applicator device is an applicator brush. It will be appreciated that while a brush is an example of a suitable applicator, particularly for hair, other applicators may be used, including but not limited to spray bottles, squeeze bottles, one and two chamber pumps, tubes, combs, and other applicators known in the art.

[00443] Heat (at a temperature of at least 40°C) can be applied to the hair while the smoothing action is performed on the hair. The heat source can be chosen from a blow dryer, a flat iron, a hair dryer, a heat lamp, a heat wand, or other similar devices.

[00444] In addition, independently of the embodiment use, the composition present on the fibers or hair is left in place for a time, generally, from about 1 to about 60 minutes, such as from about 5 to about 45 minutes, or such as from about 5 to about 20 minutes, or such as from about 10 to about 20 minutes, or such as of about 20 minutes or such as of about 10 minutes. In alternate embodiments, the treatment times may be longer, and in some embodiments, appreciably longer, such that the application may be left on for up to 24 hours to about 48 hours.

[00445] The compositions of the present invention are easy to spread on hair.

[00446] It has been surprisingly and unexpectedly discovered that the application of the composition onto the hair results in the retention of the shape or style or curl of hair or of making the hair humidity resistant. It was also surprisingly and unexpectedly discovered that the application of the composition onto the hair results in improving the quality of the hair, for example, better hair feel and appearance.

[00447] It has also been surprisingly and unexpectedly discovered that the application of the composition onto the hair results in the retention of the shape or style or curl of hair or of making the hair humidity resistant while retaining good cosmetic appearance and properties.

[00448] The shape/styling control, the curl retention, humidity resistant, and hair care effects obtained using the compositions and methods of the present invention may also be durable or long-lasting, i.e., wash or shampoo resistant.

[00449] As used herein, "long-lasting" or "durable" is understood to mean that the benefits imparted to hair by the compositions of the invention last over a period of time and/or over high humidity conditions and/or after one or multiple wash cycles (with water or shampoo/water or shampoo/water/conditioner/water or conditioner/water). The multiple wash cycles is understood to mean more than one wash cycle, such as two or three or four or five or six or seven or eight or nine or ten wash cycles.

[00450] Another embodiment of the present invention is method for imparting durable or long-lasting style/shape and/or curl and/or care to hair comprising (a) providing the composition of the present invention, and (b) providing instructions for applying the composition to the hair.

[00451] Instructions for applying the composition of the present invention onto keratinous substrates such as hair on the head or eyelashes may comprise directions of use of the composition for the end-user to follow. The end-user may be a consumer or cosmetologist or salon hair dresser. Directions may comprise instructing the end-user to take an amount of the composition in sufficient quantity such that the composition adequately covers the hair fibers and imparts the desired shape or style or hold to the hair fibers. Directions may additionally instruct the end-user to use a device such as a comb, brush (e.g., hair brush or brush wand), flat iron plates, blow dryer or the fingers for shaping or styling the hair or for separating the fibers of the hair. Directions may also additionally instruct the end-user to apply heat to the hair such as by blow drying the hair or using a heating device on the hair.

[00452] Instructions for applying the composition of the present invention onto keratin fibers such as hair may appear on the container (such as can, bottle or jar) holding the composition of the present invention or on the box or carton or other packaging comprising the container holding the composition.

[00453] Another embodiment of the present invention is method protecting a keratinous fiber chosen from hair comprising applying to the keratinous fiber the composition of the present invention in an amount effective to protect or repair said

keratinous fiber before or during or after chemically treating the hair (e.g., dyeing the hair using permanent, semi-permanent or demi-permanent dyeing compositions, bleaching/lightening or lifting the color of hair by chemical oxidizing agents, perming the hair using chemical reducing/oxidizing agents, relaxing the hair using lye and no-lye compositions, straightening the hair using chemical straightening agents).

[00454] The compositions described above are useful for application onto keratinous substrates such as hair on the head of human individuals.

[00455] Thus, the compositions of the present invention can be made into various cosmetic products such hair care products, hair styling products and make up products.

[00456] Representative types of hair care compositions, including hair cosmetic and styling compositions, of the present invention include compositions for shaping the hair, maintaining the shape of the hair, styling products (e.g., gels, creams, milks, pastes, waxes, ointments, serums, foams, hair lotions, mousses, pump-sprays, non-aerosol sprays and aerosol sprays), conditioning or protection from heat damage, leave-in hair treatments, rinse-off hair treatments, combination shampoo/styling compositions and hair volumizing compositions.

[00457] The compositions of the present invention can be in the form of an aqueous composition or an emulsion, such as a lotion or cream, and in some embodiments may be applied in another form, such as in a serum such as an anhydrous serum.

[00458] In one embodiment, the composition of the present invention is in the form of a non-aerosol spray, in some embodiments, containing a volatile organic solvent/compound.

[00459] In one embodiment, the composition of the present invention is in the form of a cream. In another embodiment, the composition of the present invention is in the form of an aqueous lotion (non-emulsion).

[00460] The compositions may be packaged in various forms, especially in a tube, a jar or bottles, in pump bottles, in squeeze bottles, or in aerosol containers so as to apply the composition in vaporized form or in the form of a mousse. The compositions may also impregnate applicators, especially gloves or wipes.

[00461] The composition may be applied by hand, with an applicator nozzle or actuator pump, with a container equipped with a pump, an applicator and a dispensing comb, or with an insoluble substrate impregnated with the composition.

[00462] As used herein, the processes and compositions disclosed herein may be used on the hair that has not been artificially dyed, pigmented or permed.

[00463] As used herein, the processes and compositions disclosed herein may be also used on the hair that has been artificially dyed, pigmented or permed, relaxed, straightened or other chemical process.

[00464] The compositions according to the disclosure may be prepared according to techniques that are well known to those skilled in the art.

[00465] Although the foregoing refers to various exemplary embodiments, it will be understood that the disclosure is not so limited. It will occur to those of ordinary skill in the art that various modifications may be made to the disclosed embodiments and that such modifications are intended to be within the scope of the disclosure. Where an embodiment employing a particular structure and/or configuration is illustrated in the present disclosure, it is understood that the present disclosure may be practiced with any other compatible structures and/or configurations that are functionally equivalent provided that such substitutions are not explicitly forbidden or otherwise known to be impossible to one of ordinary skill in the art.

[00466] The following examples are intended to further illustrate the present invention. They are not intended to limit the invention in any way. Unless otherwise indicated, all parts are by weight.

[00467] In some embodiments, the invention provides a cosmetic composition for application to a keratinous substrate, comprising: at least one polycarbodiimide compound; and at least one amino compound comprising selected from the group consisting of polyamines and silicone amines; wherein the at least one polycarbodiimide compound and the at least one amino compound are present in at a ratio, by weight, in the range from about 10:1 to about 1:10 of polycarbodiimide to amino compound; and wherein the composition includes amounts of each of the polycarbodiimide compound and the amino compound sufficient to impart one or more of improved color deposit, improved color retention and extended color

durability as compared with compositions comprising only one of the polycarbodiimide and amino compound.

[00468] In some embodiments, the composition comprises from about 0.1% to about 40.0%, by active weight, of the composition, of a combined amount of the polycarbodiimide and the amino compounds.

[00469] In some embodiments, the amino compound is selected from polyamines and comprising a colorant, whereby the composition imparts to the keratinous substrate improved color deposit and retention.

[00470] In some embodiments, the polycarbodiimide is present in an amount, by weight, based upon the weight of the composition, from about 0.01% to about 20%, and wherein the amino compound selected from a polyamine is present in an amount, by weight, based upon the weight of the composition, from about 0.01% to about 40%, and wherein the amino compound selected from a silicone amine is present in an amount, by weight, based upon the weight of the composition, from about 0.01% to about 40%. In some embodiments, amino compound is a polyamine selected from a vinylamine/vinylformamide copolymer.

[00471] In some embodiments, the amino compound is a silicone amine selected from amodimethicone.

[00472] In some embodiments, the invention provides a method of treating a keratinous substrate, comprising: applying to the keratinous substrate a composition of claim 1 in an amount effective to impart one or more of improved color deposit, improved color retention and extended color durability.

[00473] In some embodiments, the application to the keratinous substrate is at least a one step process selected from a one step process, wherein the composition comprising the polycarbodiimide and the amino compound is provided as a premix, and is prepared by combining the polycarbodiimide and the amino compound and at least a solvent, whereby the mixed composition is applied onto the keratinous substrate; a one step process, wherein the composition is provided in separate premixes, each premix separately comprising the polycarbodiimide, the amino compound, and the optional colorant or dye, the premixes prepared by separately combining the polycarbodiimide with at least water to form an aqueous phase, and separately combining the amino compound with at least an organic solvent to

form a non-aqueous phase, and separately combining the optional colorant or dye with a suitable solvent, whereby at the time of use, the premixes are combined and agitated to form an emulsion that is applied onto the keratinous substrate; a two-step process, wherein the composition is provided in separate premixes, the premixes prepared by separately combining the polycarbodiimide with water to form on an aqueous phase, and separately combining the amino compound with an organic solvent to form a non-aqueous phase, and separately combining the optional colorant or dye with a suitable solvent, whereby at the time of use, the premix containing the polycarbodiimide and the premix containing the amino compound are combined to form a mixture, whereby each of the mixture and the premix containing the optional colorant or dye is applied separately to the keratinous substrate in any order; and a multi-step process, wherein the composition is provided in separate premixes, the premixes prepared by separately combining the polycarbodiimide with water to form on an aqueous phase, and separately combining the amino compound with an organic solvent to form a non-aqueous phase, and separately combining the optional colorant or dye with a suitable solvent, whereby at the time of use, each of the premixes is applied separately to the keratinous substrate in any order.

[00474] In some embodiments, the invention provides a method of treating a keratinous substrate, comprising: applying to the keratinous substrate a composition of claim 1 comprising an amino compound selected from polyamines and also comprising a colorant, the combination in an amount effective to impart one or more of improved color deposit, improved color retention and extended color durability.

[00475] In some embodiments, the invention provides a method of treating a keratinous substrate, comprising: applying to the keratinous substrate a composition of claim 1 an amino compound selected from silicone amines in an amount effective to impart one or more of improved color deposit, improved color retention and extended color durability.

[00476] In some embodiments, the invention provides an article of manufacture comprising a kit containing, in separately packaged form, the kit comprising: at least one of: a composition according to claim 1 wherein the polycarbodiimide, the optional colorant or dye, and amino compound are combined and the composition further comprises at least a solvent; and a composition according to claim 1 wherein the polycarbodiimide, the optional colorant or dye, and amino compound are

provided in two or more separate packages, whereby at the time of use, the contents of the packages are one or more of combined and agitated to form an emulsion, and directly applied to the keratinous substrate.

[00477] In some embodiments, the invention provides a cosmetic composition for application to a keratinous substrate, comprising: at least one polycarbodiimide compound; and at least one amino compound comprising at least one polyvinylamine; wherein the polycarbodiimide compound and the amino compound comprising the polyvinylamine are present in at a ratio, by weight, in the range from about 10:1 to about 1:10 of polycarbodiimide to polyvinylamine; and wherein the composition includes amounts of each of the polycarbodiimide compound and the polyvinylamine sufficient to impart one or more of impart one or more of lasting style-humidity resistance and increased styling hold as compared with compositions comprising only one of the polycarbodiimide and polyvinylamine compounds.

[00478] In some embodiments, the composition comprises from about 0.1% to about 40.0%, by active weight, of the composition, of a combined amount of the polycarbodiimide and the polyvinylamine compounds.

[00479] In some embodiments, the composition comprises from about 0.25% to about 20.0%, by weight, of the composition, of a combined amount of the polycarbodiimide and the polyvinylamine compounds.

[00480] In some embodiments, the composition comprises from about 1% to about 10.0%, by weight, of the composition, of a combined amount of the polycarbodiimide and the polyvinylamine compounds.

[00481] In some embodiments, the hold imparted to the keratinous substrate confers improved bending force property to the substrate.

[00482] In some embodiments, the at least one additive comprising one or more rheology modifiers and thickening/viscosity-modifying agents are water-soluble or water-dispersible compounds is selected from acrylic polymers, non-acrylic polymers, starch, saccharide-based polymers (e.g., guar, guar gums), cellulose-based polymers (in particular, hydroxyethylcellulose, cellulose gums, alkyl hydroxyethyl cellulose, carboxylic acid containing celluloses/carbohydrates), non-polymeric and polymeric gelling agents, silica particles, clay, hyaluronic acid, alginic acid, and mixtures thereof.

[00483] In some embodiments, the composition further comprising at least one or more additional compounds selected from polymeric (for example, cellulosic) based thickeners, amphoteric surfactants, nonionic fixing polymers, cationic surfactants, polyols, and propellants.

[00484] In some embodiments, the polyvinylamine is a vinylamine/vinylformamide copolymer.

[00485] In some embodiments, the composition further comprising at least one or more additional compounds selected from polymeric (for example, cellulosic) based thickeners, amphoteric surfactants, nonionic fixing polymers, cationic surfactants, polyols, and propellants.

[00486] In some embodiments, the polycarbodiimide is present in an amount, by weight, based upon the weight of the composition, from about 0.01% to about 20% and wherein the polyvinylamine is present in an amount, by weight, based upon the weight of the composition, from about 0.1% to about 40%.

[00487] In some embodiments, the invention provides a method of applying a keratinous substrate chosen from hair, eyelashes and eyebrows to enhance styling thereof, comprising: applying to the keratinous substrate the composition of claim 1 in an amount effective to impart one or more of lasting style-humidity resistance and increased styling hold.

[00488] In some embodiments, the method includes applying heat to the keratinous substrate wherein the heat is applied prior to or while or after applying the composition to the keratinous substrate.

[00489] In some embodiments, the invention provides a method for durable non-permanent shaping of at least one keratinous substrate or for durable retention of a non-permanent shape of at least one keratinous substrate comprising: applying to the at least one keratinous substrate a composition according to claim 1; optionally heating the at least one keratinous substrate; wherein when heating is employed, the composition is applied prior to the heating.

[00490] Procedure for preparation of Hair Treatment Composition (For Hair Repair or Hair Styling)

[00491] Stock solutions of each phase were generated by stirring a selected amount or percentage by weight of active RM (raw material) in the respective solvent (either water, Isododecane (IDD) or ethanol). Just before application, the desired ratio of parts (typically 1:1 actives) were weighed into a vial and shaken vigorously by hand for about 10 seconds / g of solution to create milky emulsion. Typically, 1 g of product was applied to 1 g of hair. In the case of 2-step treatments, stock solutions were applied directly to hair without pre mixing.

[00492] EXAMPLES

[00493] A: EXAMPLES WITH SILICONE AMINES

[00494] The following examples are to illustrate the invention and are non-limiting.

[00495] Raw Materials Employed in the Examples

Designations and Ingredient Names
Amino silicone compound 1 (Amodimethicone 1) Commercially available as KF 8020 from the supplier Shin Etsu
Amino silicone compound 2 (Amodimethicone 2) Commercially available as SILSOFT 253 from the supplier MOMENTIVE PERFORMANCE MATERIALS
Polycarbodiimide 1 Commercially available as V-02-L2 from the supplier Nisshinbo

[00496] A. Testing Procedures

[00497] 1) Procedure for Durability determination using High humidity curl retention (HHCR) test

[00498] Hair Treatment

[00499] Regular bleached hair swatch (from IHIP, 13.5 cm long, about 0.5 g weight) was treated with solutions of 4% by weight of active material of test solutions (0.5g solution/g hair). The hair was combed until the solution was uniformly distributed over the hair swatch surface. The treated hair was then rolled onto a spiral rod (0.5 in diameter) and allowed to:

[00500] Dry at room temperature overnight or

[00501] Dry in a 50C oven for 30 minutes and then dried at room temperature overnight.

[00502] 2) Curl Retention Measurement

[00503] The coiled hair was removed from the rod and placed in the humidity chamber at 90% RH, 40°C for 5 hours. % Curl Retention was calculated using the formula below:

$$\% \text{ Curl Retention} = \frac{(\text{Lo} - \text{Lt})}{(\text{Lo} - \text{Li})} * 100$$

Where: Lo = Original hair length (fully extended hair length)

Li = Initial hair length (length of hair before humidity exposure)

Lt = Length of hair after 5 hr humidity exposure

[00504] 2) Procedure for Hydrophobicity Test using Contact Angle

[00505] Hair Treatment

[00506] A strip or swatch of twice-bleached hair (from IHIP, 0.5 cm wide, approx. 0.75 g) was treated with the test composition (1 g treatment/g hair) and placed in an oven at 50 °C for 30 minutes, then allowed to dry overnight. The following morning, the hair was washed with a conventional sulfate-based shampoo (DOP shampoo), rinsed, dried in a helmet dryer and measured for residual hydrophobicity.

[00507] Hydrophobicity Measurement

[00508] Hydrophobicity of each swatch was measured via contact angle measurements using Biolin Scientific Contact Angle Tensiometer, Model C204A. A bundle of 30-50 fibers was clamped to create a flat surface. A 3 uL drop of DI H2O was placed on the fiber surface and the contact angle was measured for 10 seconds. The values reported below are an average of 3 measurements using the contact angle at 10 seconds.

[00509] Sufficiently porous hair or hydrophilic hair will not support a droplet for a full 10 seconds. In these cases, the time for the droplet to fully absorb/spread is instead reported.

[00510] I. High Humidity Curl Retention of Hair Treated with Amino silicone compound 1 and Polycarbodiimide 1

[00511] Hair swatches were treated with the following 4% active solutions (0.5g/g hair):

[00512] 4% Amino silicone compound 1 in Isododecane

[00513] 2% Amino silicone compound 1 (in Isododecane)+ 2% polycarbodiimide 1 in water

[00514] 4% polycarbodiimide 1 in water

[00515] The hair was then dried overnight around spiral curling rods. The high humidity curl retention (HHCR) results are shown below.

[00516] Table 1

Treatment	% Curl Retained after 5 hours
4% Amino silicone compound 1 in Isododecane	13.04%
2% Amino silicone compound 1 (in Isododecane) + 2% polycarbodiimide 1	28.36%
4% polycarbodiimide 1	4%

[00517] The results indicate that hair treated with the inventive compositions at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature compared to hair treated with either material alone. The hair treated with the inventive composition displayed a greater styling/curl hold over time and at high humidity condition as evidenced by the higher curl retention value as compared to the hair swatches treated with either material alone which demonstrated lower curl retention values, indicating less styling/curl hold over time and at high humidity. Thus, incorporating polycarbodiimide produces a coating on hair with increased humidity resistance through crosslinking interactions with the amine silicone and hair.

[00518] II. High Humidity Curl Retention of Hair Treated with Amino silicone compound 1 and Polycarbodiimide 1 and with Heat

[00519] Three hair swatches were treated with the 4% active treatment solutions (0.5g of product/g of hair) prepared as described in Example I above.

[00520] The hair was then dried in a 50°C oven for 30 minutes, followed by further drying at room temperature overnight on spiral curling rods. The HHCR results are shown below.

[00521] Table 2

Treatment	% Curl Retained after 5 hours
4% Amino silicone compound 1 in Isododecane	17.46%
2% Amino silicone compound 1 (in Isododecane) + 2% polycarbodiimide 1	33.33%
4% polycarbodiimide 1	0%

[00522] The results indicate that hair treated with the inventive compositions and subjected to drying with heat (at 50°C for 30 minutes) followed by drying at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature as compared to hair treated with either material alone. In addition, percent curl retention for the hair treated with the inventive composition was greater when heat was employed as compared to percent curl retention obtained when heat was not used (see Table 1). It can be expected that the same or similar performance as obtained in accordance with the invention can be achieved using other types of heating tools such as a blow drier, flat iron, hot iron, steam/hot rollers and the like.

[00523] III. High Humidity Curl Retention of Hair Treated with Amino silicone compound 2 and Polycarbodiimide 1

[00524] Hair swatches were treated with 4% active solutions (0.5g/g hair) of the following compositions:

4% Amino silicone compound 2 in Isododecane

2% Amino silicone compound 2 (in Isododecane)+ 2% polycarbodiimide 1

4% polycarbodiimide 1

[00525] The hair was then dried overnight around spiral curling rods. The high humidity curl retention (HHCR) results are shown below.

[00526] Table 3

Treatment	% Curl Retained after 5 hours
4% Amino silicone compound 2 in Isododecane	13.04%
2% Amino silicone compound 2 (in Isododecane) + 2% polycarbodiimide 1	29.23%
4% polycarbodiimide 1	8.06%

[00527] The results indicate that hair treated with the inventive compositions at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature compared to hair treated with either material alone. The hair treated with the inventive composition displayed a greater styling/curl hold over time and at high humidity condition as evidenced by the higher curl retention value as compared to the hair swatches treated with either material alone which demonstrated lower curl retention values, indicating less styling/curl hold over time and at high humidity. Thus, incorporating polycarbodiimide produces a coating on hair with increased humidity resistance through crosslinking interactions with the amine silicone and hair.

[00528] IV. High Humidity Curl Retention of Hair Treated with Amino silicone compound 2 and Polycarbodiimide 1 and with Heat

[00529] Three hair swatches were treated with 4% active treatment solutions (0.5g of product/g of hair) prepared as described in Example I above.

[00530] The hair was then dried in a 50°C oven for 30 minutes, followed by further drying at room temperature overnight on spiral curling rods. The high humidity curl retention results are shown below.

[00531] Table 4

Treatment	% Curl Retained after 5 hours
4% Amino silicone compound 2 in Isododecane	17.46%
2% Amino silicone compound 2 (in Isododecane) + 2% polycarbodiimide 1	35.29%
4% polycarbodiimide 1	11.94%

[00532] The results indicate that hair treated with the inventive compositions and subjected to drying with heat (at 50°C for 30 minutes) followed by drying at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature as compared to hair treated with either material alone. In addition, percent curl retention for the hair treated with the inventive composition was greater when heat was employed as compared to percent curl retention obtained when heat was not used (see Table 3). It can be expected that the same or similar performance as obtained in accordance with the invention can be achieved using other types of heating tools such as a blow drier, flat iron, hot iron, steam/hot rollers and the like.

[00533] The above examples show that the crosslinking interactions between the amino silicone compounds and the polycarbodiimide and the hair results in better style and shape memory as evidence by the resiliency of the hair style/curl against high humidity.

[00534] V. Hydrophobicity of Hair Treated with Amino silicone compound 1 and Polycarbodiimide 1

[00535] Three hair swatches were treated with the following compositions (1 g product/g hair):

2% amino silicone compound 1 in isododecane

2% amino silicone compound 1 in isododecane + 2% polycarbodiimide 1 in water

2% polycarbodiimide 1 in water

[00536] The hair was then placed in a 50°C oven for 30 minutes, then dried overnight at room temperature. After shampooing the following day, swatches exhibited these contact angles:

[00537] Table 5

Treatment	Contact Angle After Shampoo
2% Amino silicone compound 1 in Isododecane	0°
2% Amino silicone compound 1 (in Isododecane) + 2% polycarbodiimide 1	107.3 ± 1.6
2% polycarbodiimide 1	87.7 ± 2.9°

[00538] The contact angle measurements above show that the combination of polycarbodiimide with the amino silicone compound resulted in increased hydrophobicity imparted to the hair even after the hair has been shampooed, i.e., the hydrophobicity imparted to hair was shampoo resistant. In contrast, the results indicate that the amino silicone compound did not impart hydrophobicity to hair as shown by the zero contact angle and that the polycarbodiimide imparted less hydrophobicity to hair.

[00539] VI. High humidity curl retention (HHCR) test and Shampoo Resistance

[00540] Hair Treatment

[00541] Wash hair swatches from Testing Method 1 (Apply product (allow to dry with or without heat, run high humidity curl retention at 90% humidity 40 C). Remove swatches from humidity chamber and allow to sit at ambient room temperature.

[00542] Washing Treatment

[00543] Wash hair with 0.4g of commercially available shampoo/ g hair. Massage hair for 10 seconds with shampoo and rinse with water for 20 seconds. Comb the hair twice to detangle hair. Wrap the hair swatch around the curling rod. Allow to dry overnight at room temperature.

[00544] Curl Retention Measurement

[00545] The coiled hair was removed from the rod and placed in the humidity chamber at 90% RH, 40°C for 5 hours. % Curl Retention was calculated as described above.

[00546] The swatches were originally dried in a 50°C oven for 30 minutes and then dried at room temperature after 1 shampoo. No additional heat was used to dry once the swatches were washed.

[00547] Table 6

Treatment	% Curl Retained after 5 hours
4% Amino silicone compound in Isododecane	23.08%
2% Amino silicone compound (in Isododecane) + 2% polycarbodiimide 1	34.25%
4% polycarbodiimide 1	13.89%

[00548] The results indicate that hair treated with the inventive compositions at room temperature has increased percent curl retained indicating higher resistance to shampooing, high humidity, and high temperature compared to hair treated with either material alone. The inventive composition displayed a greater styling/curl hold over time and through shampoo treatment at high humidity condition as indicated by the higher curl retention value. In contrast, the hair treated with either material alone demonstrated lower curl retention values, indicating less styling hold over time and through shampoo treatment at high humidity. Thus, incorporating polycarbodiimide produces a coating on hair with increased humidity resistance through crosslinking interactions with the amine silicone and hair, with or without a heating step.

[00549] B: EXAMPLES WITH AMINES/POLYAMINES

[00550] Raw Materials Employed in the Examples

Designations and Ingredient Names
polyvinylamine or PVA INCI name is Vinylamine/vinylformamide copolymer; Commercially available as LUVIQUAT 9030 from the supplier BASF
alkoxylated polyamine Commercially available as JEFFAMINE T-5000 from the supplier Huntsman
Polycarbodiimide 1 Commercially available as V-02-L2 from the supplier Nisshinbo

[00551] A. Testing Procedures

[00552] 1) Procedure for Durability determination using High humidity curl retention (HHCR) test

[00553] Hair Treatment

[00554] Regular bleached hair swatch (from IHIP, 13.5 cm long, about 0.5 g weight) was treated with solutions of 4% by weight of active material of test solutions (0.5g solution/g hair). The hair was combed until the solution was uniformly distributed over the hair swatch surface. The treated hair was then rolled onto a spiral rod (0.5 in diameter) and allowed to:

[00555] Dry at room temperature overnight or

[00556] Dry in a 50C oven for 30 minutes and then dried at room temperature overnight.

[00557] Curl Retention Measurement

[00558] The coiled hair was removed from the rod and placed in the humidity chamber at 90% RH, 40°C for 5 hours. % Curl Retention was calculated using the formula below:

[00559] % Curl Retention = $\frac{(Lo - Lt)}{Lo} * 100$

[00560] $(Lo - Li)$

[00561] Where: Lo = Original hair length (fully extended hair length)

[00562] Li = Initial hair length (length of hair before humidity exposure)
Lt = Length of hair after 5 hr humidity exposure

[00563] 2) Procedure for Determination of the mechanical property of treated hair using Three Point Bending

[00564] Hair Treatment

[00565] A strip of normal hair (from IHIP, 1 cm in width, 15 cm in length, about 2.0 - 2.5 g of hair) was treated with the tested solution (0.5 g of aqueous solution/g hair). The hair was combed through until the solution was uniformly distributed over the surface of the tress. The treated hair, in a straight configuration, was then allowed to dry overnight at room temperature.

[00566] Three-point Bending Measurement

[00567] The test was conducted using a texture analyzer (Model TA-XTPlus, Texture Technologies Corporation) equipped with a hair mounting accessory as described in J. Cosmet. Sci., 53, 345-362 (November/December 2002). The cantilever bending experiment consisted of the following sequence of steps: the hair tress was placed on a 2-point of 6 cm width, and the probe, representing the third point, came down at the middle of the hair tress and performed 10 cycles of 10-mm deformations of the hair tress. The testing protocol was:

[00568] Test mode = Compression

[00569] Pre-test speed = 2 mm/sec

[00570] Test speed = 2 mm/sec

[00571] Post-test speed = 2 mm/sec

[00572] Target mode = Distance

[00573] Distance = 10 mm

[00574] Count = 10

[00575] Trigger type = Auto (Force)

[00576] Trigger force = 1 g

[00577] After finishing 10 cycles of bending, a plot of force as a function of distance of 10 deformations was generated. From the plot, the maximum force in the first deformation was determined.

[00578] A high maximum force indicates that the hair was stiff with strong hold, and a lower maximum force indicates that the hair was softer with weaker hold.

[00579] Each experiment was run three times, and the results are reported from the average of the three experiments.

[00580] 3) Procedure for Hydrophobicity Test using Contact Angle

[00581] Hair Treatment

[00582] A strip or swatch of twice-bleached hair (from IHIP, 0.5 cm wide, approx. 0.75 g) was treated with the inventive composition (1 g treatment/g hair) and placed in an oven at 50 °C for 30 minutes, then allowed to dry overnight. The following morning, the hair was washed with a conventional sulfate-based shampoo (DOP shampoo), rinsed, dried in a helmet dryer and measured for residual hydrophobicity.

[00583] Hydrophobicity Measurement

[00584] Hydrophobicity of each swatch was measured via contact angle measurements using Biolin Scientific Contact Angle Tensiometer, Model C204A. A bundle of 30-50 fibers was clamped to create a flat surface. A 3 µL drop of DI H₂O was placed on the fiber surface and the contact angle was measured for 10 seconds. The values reported below are an average of 3 measurements using the contact angle at 10 seconds.

[00585] B. Examples

[00586] I. High Humidity Curl Retention of Hair Treated with Polyvinylamine and polycarbodiimide 1

[00587] Hair swatches were treated with 4% active solutions (0.5g/g hair):

[00588] 4% Polyvinylamine in water

[00589] 2% Polyvinylamine + 2% Polycarbodiimide 1 in water

[00590] 4% Polycarbodiimide 1 in water

[00591] The hair was then dried overnight at ambient conditions around curling rods. Hair was removed from the curling rods and placed in the humidity chamber for

5 hours at 90% humidity and 40 C. The high humidity curl retention results are shown below.

[00592] Table 1

Treatment	% Curl Retained after 5 hours
4% PVA	14.49%
2% PVA + 2% polycarbodiimide 1	47.89%
4% polycarbodiimide 1	10.14%

[00593] The results the table above indicate that hair treated with the inventive compositions at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature compared to hair treated with either material alone. The hair treated with the inventive composition displayed a greater styling/curl hold over time and at high humidity condition as evidenced by the higher curl retention value as compared to the hair swatches treated with either material alone which demonstrated lower curl retention values, indicating less styling/curl hold over time and at high humidity. Thus, combining polycarbodiimide with an amino compound resulted in a coating on hair that imparted increased humidity resistance properties to hair achieved through interactions of the polycarbodiimide with the amino compound and the hair.

[00594] II. High Humidity Curl Retention of Hair Treated with Polyvinylamine and Polycarbodiimide 1 with Heat

[00595] Three hair swatches were treated with 4% active treatment solutions (0.5g/g of product):

[00596] 4% Polyvinylamine in water

[00597] 2% Polyvinylamine + 2% Polycarbodiimide 1 in water

[00598] 4% Polycarbodiimide 1 in water

[00599] The hair was then dried in a 50C oven for 30 minutes, followed by further drying at room temperature overnight on spiral curling rods. Hair is then removed from the curling rods and placed in the humidity chamber for 5 hours at 90% humidity and 40 C. The high humidity curl retention results are shown below.

[00600] Table 2

Treatment	% Curl Retained after 5 hours
4% PVA	23.08%
2% PVA + 2% polycarbodiimide 1	72.86%
4% polycarbodiimide 1	17.46%

[00601] The results in the table above indicate that hair treated with the inventive compositions and subjected to drying with heat (at 50°C for 30 minutes) followed by drying at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature as compared to hair treated with either material alone. In addition, percent curl retention for the hair treated with the inventive composition was greater when heat was employed as compared to percent curl retention obtained when heat was not used (see Table 1). It can be expected that the same or similar performance as obtained in accordance with the invention can be achieved using other types of heating tools such as a helmet drier (as in the salon) blow drier, heat lamp, curling iron or any other tool as deemed appropriate.

[00602] III. High Humidity Curl Retention of Hair Treated with alkoxylated polyamine and Polycarbodiimide 1

[00603] Hair swatches were treated with 4% active solutions (0.5g/g hair) of the following compositions:

[00604] 4% alkoxylated polyamine in ethanol

[00605] 2% alkoxylated polyamine in ethanol + 2% Polycarbodiimide 1 in water

[00606] 4% Polycarbodiimide 1 in water

[00607] The hair was then dried overnight around the curling rods. Hair was then removed from the curling rods and placed in the humidity chamber for 5 hours at 90% humidity and 40 C. The high humidity curl retention results are shown below.

[00608] Table 3

Treatment	% Curl Retained after 5 hours
4% alkoxylated polyamine	0%
2% alkoxylated polyamine + 2% polycarbodiimide 1	22.39%
4% polycarbodiimide 1	8.93%

[00609] The results in the table above indicate that hair treated with the inventive compositions at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature compared to hair treated with either material alone. The hair treated with the inventive composition displayed a greater styling/curl hold over time and at high humidity condition as evidenced by the higher curl retention value as compared to the hair swatches treated with either material alone which demonstrated lower curl retention values, indicating less styling/curl hold over time and at high humidity. Thus, combining polycarbodiimide with an amino compound resulted in a coating on hair that imparted increased humidity resistance properties to hair achieved through interactions of the interactions of the polycarbodiimide with the amino compound and the hair.

[00610] IV. High Humidity Curl Retention of Hair Treated with alkoxylated polyamine and Polycarbodiimide 1 with Heat

[00611] Active solutions were prepared as described in Example IV above.

[00612] Three hair swatches were treated with 4% active treatment solutions (0.5g/g of product):

[00613] 4% alkoxylated polyamine in ethanol

[00614] 2% alkoxylated polyamine in ethanol + 2% Polycarbodiimide 1 in water

[00615] 4% Polycarbodiimide 1 in water

[00616] The hair was then dried in a 50C oven for 30 minutes, followed by further drying at room temperature overnight on spiral curling rods. Hair was then removed from the curling rods and placed in the humidity chamber for 5 hours at 90% humidity and 40 C. The high humidity curl retention results are shown below.

[00617] Table 4

Treatment	% Curl Retained after 5 hours
4% alkoxyated polyamine	0%
2% alkoxyated polyamine + 2% polycarbodiimide 1	28.57%
4% polycarbodiimide 1	26.15%

[00618] The results in the table above indicate that hair treated with the inventive compositions and subjected to drying with heat (at 50°C for 30 minutes) followed by drying at room temperature exhibited increased percent curl retained indicating higher resistance to high humidity and high temperature as compared to hair treated with either material alone. In addition, percent curl retention for the hair treated with the inventive composition was greater when heat was employed as compared to percent curl retention obtained when heat was not used (see Table 3). It can be expected that the same or similar performance as obtained in accordance with the invention can be achieved using other types of heating tools such as a helmet drier (as in the salon) blow drier, heat lamp, curling iron or any other tool as deemed appropriate.

[00619] V. Mechanical Property of Hair Treated with Polyvinylamine and Polycarbodiimide 1

[00620] Virgin (not chemically treated) hair swatches (about 2.0-2.5g) were treated with the following aqueous solutions (0.5g product/g hair) prepared as in Example I above.

[00621] 2% Polyvinylamine in water

[00622] 2% Polyvinylamine + 2% Polycarbodiimide 1 in water

[00623] 2% Polycarbodiimide 1 in water

[00624] The treated hair swatches were dried at room temperature overnight. A 3-point bending test was performed on these hair swatches (replicates of 3) to determine the maximum force (FMax) needed to bend the hair 10 cm downward.

[00625] Table 5

Treatment	Maximum Force (g)
2% PVA	380
2% PVA + 2% polycarbodiimide 1	828
2% polycarbodiimide 1	60

[00626] The results indicate that hair treated with the inventive compositions has significantly increased stiffness, at least 2 times stiffer, up to 138 times stiffer, as compared to hair treated with either PVA or polycarbodiimide alone. The maximum force obtained using the inventive composition was also significantly greater than the combined maximum forces obtained using each material alone. The significantly increased stiffness of the hair treated with the inventive composition also indicates a stronger hold on hair. Incorporating polycarbodiimide into the coating increases the stiffness through the interaction of the polycarbodiimide with the amino compound and the hair. This increased stiffness translates to improved styling/shaping performance of the coating or film.

[00627] The above examples show that the interactions between the amino compounds and the polycarbodiimide and the hair results in greater stiffness/rigidity/hold, as well as greater style and shape memory as evidenced by the resiliency of the hair style/curl against high humidity.

[00628] VI. Hydrophobicity of Damaged Hair Treated With Polyvinylamine and Polycarbodiimide 1 and Shampoo Resistance

[00629] Double-bleached hair swatches (0.5 cm wide, 0.75 g) were treated with the following aqueous solutions (1 g product/g hair):

[00630] 2% Polyvinylamine

[00631] 2% Polyvinylamine 2% Polycarbodiimide 1

[00632] 2% Polycarbodiimide 1

[00633] The treated hair swatches were placed in a 50 °C oven for 30 minutes, then dried at room temperature overnight. Swatches were shampooed 10 times (10

shampoo/wash cycles) using a conventional sulfate-based shampoo. The following contact angles were measured:

[00634] Table 6

Treatment	Contact Angle (°)
2% PVA	112.6 ± 3.7°
2% PVA + 2% polycarbodiimide 1	123.3 ± 2.2°
2% polycarbodiimide 1	0

[00635] The contact angle measurements in the table above show that the combination of polycarbodiimide with the amino compound resulted in increased hydrophobicity imparted to the hair even after the hair has been shampooed ten times, i.e., the hydrophobicity imparted to hair was shampoo resistant. In contrast, the polycarbodiimide did not impart hydrophobicity to hair as shown by the zero contact angle and amino compound imparted less hydrophobicity to hair.

[00636] VII. High humidity curl retention (HHCR) test and Shampoo Resistance

[00637] Procedure

[00638] Hair Treatment

[00639] Hair swatches that were treated according to Examples I and II above (Tables 1 and 2) were washed as described in the following:

[00640] Washing Treatment

[00641] Hair was treated with 0.4g of commercially available shampoo / g hair. The hair was massaged for 10 seconds with shampoo and rinsed with water for 20 seconds. The hair was combed twice to detangle hair. The hair swatch was wrapped around a curling rod and allowed to dry overnight at room temperature.

[00642] Curl Retention Measurement

[00643] The coiled hair was removed from the rod and placed in the humidity chamber at 90% RH, 40°C for 5 hours. % Curl Retention was calculated as described above.

[00644] 1) Shampoo Resistance Test Results (HHCR values) on Hair Treated According to Example I (Table 1)

[00645] Hair swatches treated with the active solutions were shampooed and dried overnight around the curling rods.

[00646] Table 7

Treatment	% Curl Retained after 5 hours
4% PVA in water	23.08%
2% PVA + 2% polycarbodiimide 1 in water	35.21%
4% polycarbodiimide 1 in water	14.29%

[00647] The results in the table above indicate that hair treated with the inventive compositions at room temperature has increased percent curl retained indicating higher resistance to shampooing, high humidity, and high temperature conditions compared to hair treated with either material alone. The inventive composition displayed a greater styling/curl hold over time and through shampoo treatment at high humidity condition as indicated by the higher curl retention value. In contrast, the hair treated with either material alone demonstrated lower curl retention values, indicating less styling hold over time and through shampoo treatment at high humidity. Thus, the hair that was treated with inventive composition exhibited significantly better wash/shampoo resistance properties as compared to hair treated with each material alone.

[00648] 2) Shampoo Resistance (with heat) Test Results (HHCR values) on Hair Treated According to Example II (Table 2)

[00649] These swatches were originally dried in a 50°C oven for 30 minutes and then dried at room temperature after 1 shampoo. No additional heat was used to dry once the swatches were washed.

[00650] Table 8

Treatment	% Curl Retained after 5 hours
4% PVA	23.61%
2% PVA + 2% polycarbodiimide 1	57.14%
4% polycarbodiimide 1	13.89%

[00651] The results indicate that hair treated with the inventive compositions at room temperature has increased percent curl retained indicating higher resistance to shampooing, high humidity, and high temperature compared to hair treated with either material alone. The inventive composition displayed a greater styling/curl hold over time and through shampoo treatment at high humidity condition as indicated by the higher curl retention value. In contrast, the hair treated with either material alone demonstrated lower curl retention values, indicating less styling hold over time and through shampoo treatment at high humidity. Thus, the hair that was treated with inventive composition and subjected to heat exhibited significantly better wash/shampoo resistance properties as compared to hair treated with each material alone.

[00652] In addition, the percent curl retention for the hair treated with the inventive composition was greater when heat was employed as compared to percent curl retention obtained when heat was not used (see Table 7). It can be expected that the same or similar performance as obtained in accordance with the invention can be achieved using other types of heating tools such as a helmet drier (as in the salon) blow drier, heat lamp, curling iron or any other tool as deemed appropriate.

[00653] It is to be understood that the foregoing describes preferred embodiments of the disclosure and that modifications may be made therein without departing from the spirit or scope of the disclosure as set forth in the claims.

[00654] C: EXAMPLES WITH POLYVINYLAMINES

[00655] Procedure for preparation of Hair Treatment Composition (For Hair Repair or Hair Styling)

[00656] Stock solutions of each phase were generated by stirring a selected amount or percentage by weight of active RM (raw material) in the selected solvent (either water, or mixture of water and organic solvent such as Isododecane (IDD) or ethanol, or organic solvent). Just before application, the desired ratio of parts (typically 2:1 actives) were weighed into a vial and mixed to create the hair treatment solution. When the two phases comprise an aqueous phase and a non-aqueous phase, the two phases in the vial were agitated or shaken to create an emulsion. Typically, 0.25 to 1 g of product was applied to 0.5 to 2 g of hair. In the case of 2-step treatments, stock solutions are applied directly to hair without pre mixing.

[00657] TESTING PROCEDURES

[00658] 1) Procedure for Durability determination using High humidity curl retention (HHCR) test

[00659] Hair Treatment

[00660] Regular bleached hair swatch (from IHIP, 13.5 cm long, about 0.5 g weight) was treated with solutions of active material of test solutions (0.5g solution/g hair). The hair was combed until the solution was uniformly distributed over the hair swatch surface. The treated hair was then rolled onto a spiral rod (0.5 in diameter) and allowed to:

[00661] Dry at room temperature overnight or

[00662] Dry in a 60C oven for 30 minutes and then dried at room temperature overnight.

[00663] Curl Retention Measurement

[00664] The coiled hair was removed from the rod and placed in the humidity chamber at 80% RH, 25°C for 5 hours. % Curl Retention was calculated using the formula below:

[00665] % Curl Retention = $\frac{(Lo - Lt)}{Li} * 100$

[00666] $(Lo - Li)$

[00667] Where: Lo = Original hair length (fully extended hair length)

[00668] Li = Initial hair length (length of hair before humidity exposure)

Lt = Length of hair after 5 hr humidity exposure

[00669] 2) Procedure for Determination of the mechanical property of treated hair using Three Point Bending

[00670] Hair Treatment

[00671] A strip of normal hair (from IHIP, 1 cm in width, 15 cm in length, about 2.0 - 2.5 g of hair) was treated with the tested solution (0.5 g of aqueous solution/g hair). The hair was combed through until the solution was uniformly distributed over the surface of the tress. The treated hair, in a straight configuration, was then allowed to dry overnight at room temperature.

[00672] Three-point Bending Measurement

[00673] The test was conducted using a texture analyzer (Model TA-XTPlus, Texture Technologies Corporation) equipped with a hair-mounting accessory as described in J. Cosmet. Sci., 53, 345-362 (November/December 2002). The cantilever bending experiment consisted of the following sequence of steps: the hair tress was placed on a 2-point of 6 cm width, and the probe, representing the third point, came down at the middle of the hair tress and performed 10 cycles of 10-mm deformations of the hair tress.

[00674] The testing protocol included the following parameters: Test mode = Compression; Pre-test speed = 2 mm/sec; Test speed = 2 mm/sec; Post-test speed = 2 mm/sec; Target mode = Distance; Distance = 10 mm; Count = 10; Trigger type = Auto (Force); Trigger force = 1 g.

[00675] After finishing 10 cycles of bending, a plot of force as a function of distance of 10 deformations was generated. From the plot, the maximum force in the first deformation was determined. A high maximum force indicates that the hair was stiff with strong hold, and a lower maximum force indicates that the hair was softer with weaker hold.

[00676] Each experiment was run three times, and the results are reported from the average of the three experiments.

[00677] EXAMPLES

[00678] Raw Materials Employed in the Examples

[00679] A. Designations and Ingredient Names:

[00680] Polyvinylamine or PVA (INCI name is Vinylamine/vinylformamide copolymer; Commercially available as LUVIQUAT 9030 from the supplier BASF)

[00681] Polycarbodiimide 1 (Commercially available as V-02-L2 from the supplier Nisshinbo)

[00682] B. Examples of Exemplary Compositions

[00683] In an exemplary embodiment, a composition according to the invention includes the components as listed in Table 1A, comprising polyvinylamine, combined with polycarbodiimide in the amounts listed in Table 1B, at a ratio of from about 1:1 to about 1:2 of polycarbodiimide to the polyvinylamine-containing composition:

[00684] TABLE 1A: Formula 1, Cosmetic Composition comprising polyvinylamine

Component	Weight % Active
Non-ionic surfactants	0.23
Polyamine (polyvinylamine)	0.76
Solvent/Propellants	7.88
Cationic conditioning agent	0.20
Film Former	3.29
Silicone, Oils	1.02
Fragrance	0.47
Water	85.48

[00685] TABLE 1B: Simplex solution of polycarbodiimide (in water) added to Formula 1

Ratio polycarbodiimide to polyvinylamine	Active % polycarbodiimide
1:1	0.76
1:2	0.38

[00686] I. High Humidity Curl Retention of Hair Treated with Polyvinylamine and polycarbodiimide 1

[00687] Hair swatches were treated with compositions (0.5 g of product/g of hair) comprising: polycarbodiimide and a composition comprising polyvinylamine, in the ratios as listed below, at room temperature (25C) and with heat (60C). The hair was then dried overnight at ambient conditions around curling rods. Hair was removed from the curling rods and placed in the humidity chamber for 5 hours at 80% humidity and 25C.

[00688] TABLE 2: Treatment % Curl Retained (at RT, 25C)

Treatment	% Curl Retained after 5 hrs
Polycarbodiimide	42%
Formula 1	18%
Polycarbodiimide : Polyvinylamine (in Formula 1) : at 1:2 ratio	44%
Polycarbodiimide : Polyvinylamine (in Formula 1) at 1:1 ratio	48%

[00689] TABLE 3: Treatment % Curl Retained (with heat treatment at 60 C)

Treatment	% Curl Retained after 5 hrs
Polycarbodiimide	42%
Formula 1	23%
Polycarbodiimide : Polyvinylamine (in Formula 1) at 1:2 ratio	50%
Polycarbodiimide : Polyvinylamine (in Formula 1) at 1:1 ratio	72%

[00690] The results the table above indicate that hair treated with the inventive compositions at room temperature exhibited enhanced percent curl retained as compared with hair treated with Formula 1 comprising polyvinylamine alone. Marked enhancement was observed with the compositions treated with heat, indicating higher resistance to high humidity and high temperature compared to hair treated with either material alone.

[00691] Hair treated with the inventive composition displayed a greater styling/curl hold over time and at high humidity condition as evidenced by the higher curl retention value when treated at high temperature as compared to the hair swatches treated with either material alone which demonstrated lower curl retention values, indicating less styling/curl hold over time and at high humidity. Thus, combining polycarbodiimide with an amino compound resulted in a film coating on hair that imparted increased humidity resistance properties to hair achieved through interactions of the polycarbodiimide with the amino compound and the hair.

[00692] II. Mechanical Property of Hair Treated with Polyvinylamine and Polycarbodiimide 1

[00693] Virgin (not chemically treated) hair swatches (about 2.0-2.5g) were treated with solutions (0.5g product/g hair) prepared as in Example I above. The treated hair swatches were dried at room temperature overnight. A 3-point bending test was performed on these hair swatches (replicates of 3) to determine the maximum force (FMax) needed to bend the hair 10 cm downward.

[00694] Table 4: Max Force (g) (at RT, 25°C)

Treatment	Maximum Force (g)
Polycarbodiimide	64
Formula 1	216
Polycarbodiimide : Polyvinylamine (in Formula 1) at 1:2 ratio	437
Polycarbodiimide : Polyvinylamine (in Formula 1) at 1:1 ratio	493

[00695] Table 5: Max Force (g) (with heat, at 60C)

Treatment	Maximum Force (g)
Polycarbodiimide	44
Formula 1	205
Polycarbodiimide : Polyvinylamine (in Formula 1) at 1:2 ratio	304
Polycarbodiimide : Polyvinylamine (in Formula 1) at 1:1 ratio	432

[00696] The results indicate that hair treated with the inventive compositions has significantly increased stiffness whether treated at room temperature or at high temperature, with the most marked enhancement observed in hair treated room temperature. The Inventive Formula 1 with polycarbodiimide showed more than twice the stiffness as compared to hair treated with Inventive Formula 1 alone, and more than six times the stiffness as compared to hair treated with polycarbodiimide alone. The maximum force obtained using the inventive composition was also significantly greater than the combined maximum forces obtained using each material alone. The significantly increased stiffness of the hair treated with the inventive composition also indicates a stronger hold on hair.

[00697] The above examples show that the interactions between the amino compounds and the polycarbodiimide and the hair results in greater stiffness/rigidity/hold, as well as greater style and shape memory as evidenced by the resiliency of the hair style/curl against high humidity.

[00698] D: EXAMPLES WITH SILICONE AMINES AND POLYAMINES FOR HAIR COLOR

[00699] Process of altering the color of hair

[00700] In some embodiments, the present invention involves altering the color of hair which may be achieved when the color of hair is lifted or lightened and/or when artificial color is deposited onto hair.

[00701] Artificial color may be derived from oxidative coloration using oxidative dye precursors, or from direct coloration using direct dyes, or from temporary coloration using temporary colorants such as pigments and natural dyes.

[00702] When lifting of the color of hair is desired, the hair treatment compositions of the present invention are capable of being mixed with an oxidizing composition containing at least oxidizing agent.

[00703] When oxidative coloration on hair is to be performed, the hair treatment compositions of the present invention additionally contain a colorant chosen from oxidative dye precursors and such compositions are capable of being mixed with an oxidizing composition containing at least oxidizing agent.

[00704] The term "mixed" and all variations of this term as used herein refers to contacting or combining or reconstituting or dissolving or dispersing or blending or shaking the hair treatment composition with the oxidizing composition. It can also mean introducing the hair treatment composition to the oxidizing composition. It may also mean placing the hair treatment composition in the same vessel or container as the oxidizing composition.

[00705] Thus, the process of altering the color of hair with an oxidizing composition in accordance with the invention comprises applying a composition for altering the color of hair comprising the hair treatment composition and the oxidizing composition of the present invention onto hair. Said composition that is applied onto hair is formed by mixing the hair treatment composition with the oxidizing composition.

[00706] The hair treatment composition can be mixed or combined with the oxidizing composition in a ratio by weight of from about 1:0.01 to about 1:10, such as from about 1:0.01 to about 1:0.05, from about 1:0.05 to about 1:0.1, from about 1:0.1 to about 1:0.5, from about 1:0.5 to about 1:1, from about 1:1 to about 1:2, from about 1:2 to about 1:3, from about 1:3 to about 1:4, from about 1:4 to about 1:5, from about 1:5 to about 1:10. Thus, in accordance with the various embodiments, an inventive composition according to the disclosure can be mixed or combined with an oxidizing composition in a ratio, by weight, from 1 to one of about 0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10, including increments and ranges therein and there between from about 1:0.01 to about 1:10.

[00707] Upon application of the composition for altering the color of hair comprising the hair treatment composition and the oxidizing composition and after a resting time (leave-on time) on the hair, for example, ranging from about 1 to about 60 minutes, such as from about 5 to about 45 minutes, or such as from about 5 to about 20 minutes, or such as from about 10 to about 20 minutes, or such as of about 20 minutes, the hair is rinsed, optionally washed with shampoo, rinsed again, optionally washed with a hair conditioning composition, and rinsed again, then dried. The shampoo and hair conditioning composition can be any conventional hair shampoo and conditioner products.

[00708] In other embodiments, the composition does not comprise a color altering composition, and is applied to the keratinous substrate either before, at the same time as, or after application of a color altering composition. In some embodiments, application before or after is immediately before or after, and in other embodiments the timeframe between application of the inventive formulations and a color altering composition may be minutes, hours or days.

[00709] In addition, independently of whether the inventive composition is applied with a color altering composition, the mixture or composition present on the fibers or hair (resulting from the extemporaneous mixing of the hair treatment and oxidizing compositions, or from the successive application of the hair treatment and oxidizing compositions, or from the application of the composition without any colorant or dye) is left in place for a time, generally, from about 1 to about 60 minutes, such as from about 5 to about 45 minutes, or such as from about 5 to about 30 minutes, or such

as from about 5 to about 20 minutes, or such as from about 10 to about 20 minutes, or such as of about 20 minutes, or such as at about 10 minutes.

[00710] The temperature during the process of altering the color of hair is between room temperature and 80°C and in certain embodiments, between room temperature and 60°C.

[00711] An effective amount of the composition is typically from about 0.1 gram to about 50 grams, and in some applications for treatment of hair, in amounts from about 20 to 60 grams, and in yet further embodiments for an abundance of hair in amounts from about 20 to about 80 grams or more. It will thus be appreciated that the amounts applied depend on the amount or volume of keratinous substrate, such as hair, to be treated and may thus fall within lower ranges for small amounts or patches of hair to the higher ranges and beyond for large amounts or patches of hair. Typical applications are to the whole head in the case of treatment of hair. It will be understood that application to the hair typically includes working the composition through the hair.

[00712] Testing procedures

[00713] Colorimetric Measurements

[00714] For measuring the degree of change in the color of hair (e.g. degree of lightening/lifting color or color deposit) after treating the hair, the color of each swatch are measured with a Minolta CM2600d spectrophotometer (specular components included, 10 degrees angle, illuminant D65) in the CIEL*a*b* system.

[00715] The L*a*b* colorimetric system is a colorimetric system that assigns each color to a position in a spherical color space. In this color space, the brightness is represented by a position in the ordinate (z-axis) direction, the hue is represented by a position in the circumferential direction, and the chroma is represented by a distance from the center axis. The position on the ordinate (z-axis) representing brightness is designated by L*, and the L* value changes from 0 corresponding to black to 100 corresponding to white. The positive direction of the x-axis corresponds to a red direction, the positive direction of the y-axis corresponds to a yellow direction, the negative direction of the x-axis corresponds to a green direction, the negative direction of the y-axis corresponds to a blue direction, and the position on the x-axis is designated by a* of which value changes from -60 to +60 and the

position on the y-axis is designated by b^* of which value changes from -60 to +60. The hue and chroma are represented by a^* value and b^* value, respectively.

[00716] Two parameters, L and ΔE (delta-E), may be measured. L^* represents the intensity of the color, a^* indicates the green/red color axis and b^* the blue/yellow color axis. The determination of ΔE values is based on L^* , a^* and b^* .

[00717] According to this system, the greater the value of L, the lighter or less intense the color. Conversely, the lower the value of L, the darker or more intense the color (this can also indicate greater color deposit when the composition contains colorants).

[00718] The ΔL or the difference between the L value for the treated hair versus the L value for the control hair swatch represents a change in the value of L: the more negative the ΔL value is, the darker the color that is deposited on the hair: $\Delta L = L_t$ (treated hair) – L_c (control hair)

[00719] Delta-E (ΔE) represents color change. If ΔE is less than 1.0 there is hardly any color difference that the human eye can see. If ΔE greater than 1.0, then there is a noticeable color difference.

[00720] Example 1: Hair Color Protection Using Polycarbodiimide and Polyamine

[00721] Objective

[00722] Use of Polycarbodiimide and Polyamine as an in-color treatment to improve the color deposit and the color retention of colored hair against shampoos.

[00723] Materials

[00724] Polycarbodiimide (Carbodilite V-10 from Nishinbo)

[00725] Vinylamine/Vinylformamide Copolymer (Lupamine 9080 from BASF)

[00726] Protocol

[00727] Normal bleach hair swatches (about 5 g) were colored with L'Oreal Excellence 6RR color cream (Intense Auburn) for 30 minutes following the following protocols:

Protocol	Components
1	Excellence 6RR only
2	Excellence 6RR with 2% Polycarbodiimide
3	Excellence 6RR with 4% Polyamine
4	Excellence 6RR with 2% Polycarbodiimide + 4% Polyamine

[00728] The following ratio was used for the coloring process:

[00729] 1 (g of hair) : 2 (g of color cream/dye) : 3 (g of 20 Vol developer) : 0.5 (g of water or material tested), where:

Protocol	Ratios
1	the ratio is 1 : 2 : 3 : 0.5 (g of water)
2	the ratio is 1: 2 : 3 : 0.25 (g of water) : 0.25 (g of 2% solution of Polycarbodiimide)
3	the ratio is 1 : 2 : 3 : 0.25 (g of water) : 0.25 (g of 4% solution of Polyamine)
4	the ratio is 1 : 2 : 3 : 0.25 (g of 2% solution of Polycarbodiimide) : 0.25 (g of 4% solution of Polyamine)

[00730] After coloring, the hair was rinsed with water for 30 seconds, blow dried and shampooed 10 times.

[00731] The L, a, b values were taken before and after the shampoos. The change in the total color, dE (delta-E), was then calculated.

[00732] Results

Protocol	a Value (after color)	dE (after 10 shampoos)
1	14.4	13.9
2	15.0	13.4
3	15.2	14.4
4	15.8	12.3

[00733] The results indicate that, compared to the untreated and the other controls, the swatch treated with color cream containing both Polycarbodiimide and Polyamine shows more red (highest a value) and retains the most color after shampoos (lowest dE).

[00734] Specifically, when Polycarbodiimide alone is added to the color composition there is no improvement in color protection as demonstrated by similar dE values. The polyamine alone decreases the color protection as demonstrated by a larger dE value compared to Protocol 1. Only the association of the polyamine and polycarbodiimide provide color protection as demonstrated by a lower dE value from Protocol 1.

[00735] The color protection provided by the association is visible to the eye as it is truer to the original color in comparison to all control swatches.

[00736] Example 2: Post Color treatment for Hair Color Protection Using Polycarbodiimide and Silicone amine

[00737] Objective

[00738] Use of Polycarbodiimide and Silicone amine as a post-color treatment to help the color retention of colored hair against shampoos.

[00739] Materials

[00740] Polycarbodiimide (Carbodilite V-02-L2 from Nishinbo)

[00741] Amodimethicone/Silicone Amine (Shin Etsu KF 8020)

[00742] Protocol

[00743] Normal bleach hair swatches (about 1 g each) were colored with L'Oreal Excellence 6RR color cream (Intense Auburn) for 30 minutes, rinsed and air dried. The following ratio was used for the coloring process:

[00744] 1 (g of hair) : 1.5 (g of color cream) : 3 (g of 20 Vol developer)

[00745] After coloration, 2g of the following treatments were applied on the colored hair, allowed to sit on the hair for 15 minutes and then the hair was blow dried:

Protocol	Treatments
1	50wt% Water + 50wt% Isododecane
2	10wt% Polycarbodiimide in Water
3	10wt% Silicone Amine in Isododecane
4	5wt% Polycarbodiimide in Water + 5wt% Silicone Amine in Isododecane

[00746] After treatment, the hair was shampooed 10 times.

[00747] The L, a, b values were taken before and after the shampoos. The change in the total color, dE (delta-E), was then calculated.

[00748] Results

Protocol	dE (after 10 shampoos)
1	7.55
2	8.74
3	4.05
4	3.52

[00749] The results indicate that, compared to the untreated and the other controls, the swatch treated with both Polycarbodiimide and Silicone amine retains the most color after shampoos (lowest dE). Specifically, when carbodilite alone is used there is a decrease in color protection as demonstrated by a higher dE value. The silicone amine alone does provide some color protection on its own as demonstrated by a lower dE value. However, the association of the silicone amine and polycarbodiimide provide the best color protection as demonstrated by the lowest dE value.

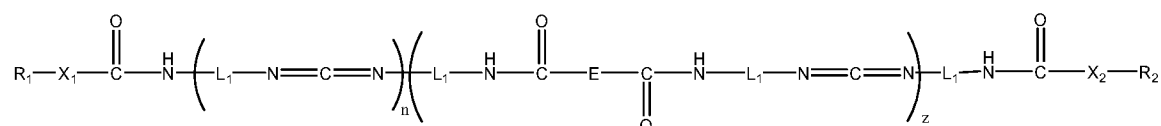
[00750] The color protection provided by the association is visible to the eye as it is truer to the original color in comparison to all controls swatches.

[00751] It is to be understood that the foregoing describes preferred embodiments of the disclosure and that modifications may be made therein without departing from the spirit or scope of the disclosure as set forth in the claims.

CLAIMS

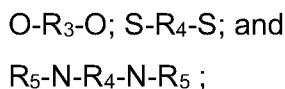
What is claimed is:

1. A composition for treatment of a keratinous substrate comprising:
 - a polycarbodiimide compound; and
 - one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof;
 wherein the composition comprises from about 0.01 to about 10.0%, by weight, of the composition of a combined amount of the polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof;
 wherein the composition includes amounts of each of the polycarbodiimide compound and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof sufficient to impart one or more of increased hydrophobicity to the keratinous substrate after application thereto and increased hold to the shape or configuration of the keratinous substrate.
2. The composition of claim 1, wherein the polycarbodiimide compound comprises a carbodiimide polymer or co-polymer and has the following formula:



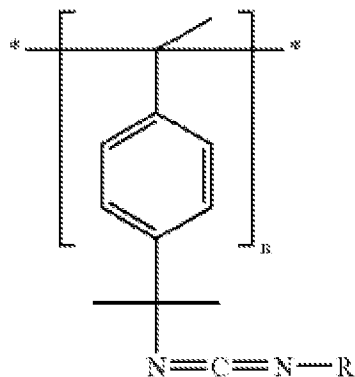
wherein X_1 and X_2 , each independently, represents O, S or NH; R_1 and R_2 , each independently, a hydrocarbon group containing one or more catenary or non-catenary hetero-atoms and containing linear or branched and cyclic or acyclic groups which are ionic or non-ionic segments or a partially or fully fluorinated hydrocarbon group containing one or more catenary or non-catenary hetero-atoms; n and z are, each independently, an integer of 0 to 20; L_1 represents a C_1 to C_{18} divalent aliphatic

hydrocarbon group, a C₃ to C₁₃ divalent alicyclic hydrocarbon group, a C₆ to C₁₄ divalent aromatic hydrocarbon group, a C₃ to C₁₂ divalent heterocyclic group, or a C₆ to C₁₄ divalent aromatic hydrocarbon group that is not chosen from m-tetramethylxylylene, wherein a plurality of L₁ groups may be identical to or different from one another; E is a radical selected from the group consisting of:



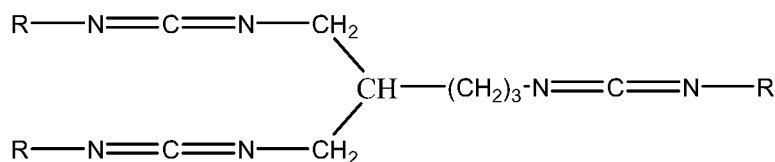
wherein R₃ and R₄ are, each independently, hydrocarbon radicals that may contain halogen atoms or one or more catenary or non-catenary hetero atoms, including an aromatic, cycloaliphatic, aryl and linear or branched alkyl radical and R₅ is hydrogen or a hydrocarbon radical, the hydrocarbon radical, when present, includes halogen atoms or one or more catenary or non-catenary hetero atoms.

3. A composition according to claim 2, wherein the polycarbodiimide compound is a co-polymer derived from alpha-methylstyryl-isocyanates having the following formula:



wherein R is an alkyl, cycloalkyl or aryl group having from 1 to 24 carbon atoms.

4. A composition according to claim 2, wherein the polycarbodiimide compound is a compound having the following structure:



wherein R is an alkyl, cycloalkyl or aryl group.

5. A composition according to claim 4, wherein R is selected from the group consisting of an alkyl group having from 1 to 24 carbon atoms, a cycloalkyl group having from 1 to 24 carbon atoms, and an aryl group having from 1 to 24 carbon atoms.
6. The composition according to claim 1, wherein the polycarbodiimide compound is present in a concentration, by weight, from about 0.1% to about 8%.
7. The composition according to claim 2, wherein the polycarbodiimide compound is present in a concentration, by weight, from about 0.25% to about 5%.
8. The composition according to claim 1, wherein the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof is present in a concentration, by weight, from about 0.01% to about 8%.
9. The composition according to claim 2, wherein the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof is present in a concentration, by weight, from about 0.25% to about 5%.
10. The composition according to claim 2, wherein the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof is a amino silicone compound selected from trimethylsilylamodimethicones, quaternary ammonium silicones, multiblock polyoxyalkylenated amino silicones, of type (AB)_n, A being a polysiloxane block and B being a polyoxyalkylenated block containing at least one amine group, alkyl amino silicones, and mixtures thereof.

11. The composition according to claim 2, wherein the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof is one of an amino silicone compound selected from amodimethicone and an amino compound selected from polyvinylamine.
12. The composition of claim 1, wherein the hydrophobicity imparted to the keratinous substrate confers one or more of a contact angle of greater than 70°, durability even after one or more wash cycles as characterized by a contact angle of between 80° and about 120°, high humidity curl retention after 5 hours of exposure in the range from about 40% to about 90%, improved bending force property to the substrate.
13. The composition according to claim 1, wherein the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof is present in an equal proportion to or greater proportion than the polycarbodiimide compound.
14. The composition according to claim 1, comprising one or more of a solvent for the polycarbodiimide selected from distilled or de-ionised water, and a solvent for one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof selected from C1-C4 lower alcohols, glycols, polyols, polyol ethers, hydrocarbons, oils, and mixtures thereof, and a colorant and/or an additive chosen from surfactants (anionic, nonionic, cationic and amphoteric/zwitterionic), polymers other than the polycarbodiimide of the invention and amino compounds other the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof of the invention such as anionic polymers, nonionic polymers, amphoteric polymers, polymeric rheology modifiers, thickening and/or viscosity modifying agents, associative or non-associative polymeric thickeners, non-polymeric thickeners, nacreous agents, opacifiers, dyes or pigments, fragrances, mineral, plant or synthetic oils, waxes including ceramides, vitamins, UV-screening agents, free-radical scavengers, antidandruff agents, hair-loss counteractants, hair restorers,

preserving agents, pH stabilizers and solvents, and mixtures thereof, wherein an additive comprising one or more rheology modifiers and thickening/viscosity-modifying agents are water-soluble or water-dispersible compounds is selected from acrylic polymers, non-acrylic polymers, starch, saccharide-based polymers (e.g., guar, guar gums), cellulose-based polymers (in particular, hydroxyethylcellulose, cellulose gums, alkyl hydroxyethyl cellulose, carboxylic acid containing celluloses/carbohydrates), non-polymeric and polymeric gelling agents, silica particles, clay, hyaluronic acid, alginic acid, and mixtures thereof.

15. A method of protecting a keratinous substrate chosen from hair, eyelashes and eyebrows from extrinsic damage caused by heating, UV radiation, chemical treatment or mechanical stress, or of repairing a keratinous fiber chosen from hair, eyelashes and eyebrows following extrinsic damage caused by heating, UV radiation, chemical treatment, or mechanical stress comprising:

applying to the keratinous substrate the composition of claim 1 in an amount effective to protect or repair said keratinous fiber; wherein the polycarbodiimide compound is present at a concentration of from about 0.01 to about 8.0% by weight, relative to the total weight of the composition

optionally further comprising: applying heat to the keratinous substrate wherein the heat is applied prior to or while or after applying the composition to the keratinous substrate.

16. A method of protecting a keratinous substrate chosen from hair, eyelashes and eyebrows from extrinsic damage caused by heating, UV radiation, chemical treatment or mechanical stress, or of repairing a keratinous substrate chosen from hair, eyelashes and eyebrows following extrinsic damage caused by heating, UV radiation, chemical treatment, or mechanical stress comprising, wherein each of the polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof of a composition according to claim 1 is provided in a premix comprising at least a solvent, and the premix is applied to the keratinous

substrate according to a process selected from a one step process and a two step process.

17. A method of treating a keratinous substrate, comprising:

applying to the keratinous substrate a composition of claim 1 in an amount effective to impart one or more of improved color deposit, improved color retention and extended color durability.

18. A method according to any one of claims 16, 17 or 18, wherein the process is at least a one step process selected from

a one step process, wherein the composition comprising the polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof is provided as a premix, and is prepared by combining the polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof and at least a solvent, whereby the premixed composition is applied onto the keratinous substrate;

a one step process, wherein the composition is provided in separate premixes, each separately comprising the polycarbodiimide and one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof, the premixes prepared by combining the polycarbodiimide with at least water to form on an aqueous phase, and separately combining one or more of a compound chosen from alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof with at least an suitable solvent, whereby at the time of use, the premixes are combined and agitated to form an emulsion that is applied onto the keratinous substrate; and

a two-step process, wherein the composition is provided in separate premixes, the premixes prepared by combining the polycarbodiimide with water to form on an aqueous phase, and separately combining one or more of a compound chosen from alkyl monoamines, alkoxylated

polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof with an suitable solvent, whereby at the time of use, the each of the premixes is applied separately to the keratinous substrate in any order.

19. A method according to claim 19, wherein the process comprises, in any order, one or more additional process steps selected from

a step of applying heat to the keratinous substrate wherein the heat is applied prior to or while or after applying any one or more premixed composition to the keratinous substrate; and

a step of processing the keratinous substrate by any one or more of processes selected from coloring, pigmenting, perming, relaxing, straightening, and highlighting, and

optionally, wherein in any combination of two or more process steps, any one or more of the premix compositions is provided for application together with any one of a coloring agent (colorant), a pigmenting agent, a permanent process agent, a relaxing process agent, a straightening process agent, and a highlighting process agent.

20. A method according to claim 20, wherein at least one premix that comprises one or both of the polycarbodiimide and the compound selected from one or more of alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof, also comprises one of the coloring agent (colorant), a pigmenting agent, a permanent process agent, a relaxing process agent, a straightening process agent, and a highlighting process agent.

21. An article of manufacture comprising a kit containing, in separately packaged form, the kit comprising:

at least one of:

a composition according to claim 1 wherein the polycarbodiimide and wherein the compound selected from one or more of alkyl monoamines, alkoxylated polyamines, alkoxylated monoamines, polyamines, and silicone amines, and mixtures thereof, are combined and the premix comprises at least a solvent; and

a composition according to claim 1 wherein the polycarbodiimide and wherein the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, are provided in in separate packages, comprising a packaged premix that comprises polycarbodiimide and at least a solvent comprising water; and also comprising a packaged premix that comprises the compound selected from one or more of alkyl monoamines, alkoxyated polyamines, alkoxyated monoamines, polyamines, and silicone amines, and mixtures thereof, with at least an suitable solvent, whereby at the time of use, the premixes are combined and agitated to form an emulsion.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/069472

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	A61Q5/00	A61Q5/02
	A61K8/84	A61K8/86
		A61Q5/06
		A61Q5/12
		A61K8/81
		A61K8/898
ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
A61Q A61K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
EPO-Internal, WPI Data, CHEM ABS Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 186 101 A (OREAL [FR]) 2 April 1970 (1970-04-02) page 1, line 38 - line 49 page 2, line 33 - line 67 -----	1,6,8, 12, 14-16, 18,19,21
X	GB 1 163 385 A (OREAL [FR]) 4 September 1969 (1969-09-04) page 1, line 27 - line 38 example 5 -----	17-20
X	KR 101 453 218 B1 (LG HOUSEHOLD & HEALTH CARE LTD [KR]) 22 October 2014 (2014-10-22) paragraphs [0021] - [0023], [0058], [0066] - [0083] claim 1 -----	1,2, 6-16,18, 21
	-/--	
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
24 February 2017		04/05/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Lenzen, Achim

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/069472

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

2(completely); 1, 6-21(partially)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/069472

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	WO 2016/052931 A1 (LG HOUSEHOLD & HEALTH CARE LTD [KR]) 7 April 2016 (2016-04-07) claim 1 -----	1,2,6-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/069472

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1186101	A	02-04-1970	BE 694956 A 04-09-1967
			CH 471582 A 30-04-1969
			DE 1617710 A1 25-03-1971
			GB 1186101 A 02-04-1970
			GB 1186102 A 02-04-1970
			IT 988301 B 10-04-1975
			LU 50572 A1 05-09-1967
			NL 6703296 A 05-09-1967
GB 1163385	A	04-09-1969	DE 1667905 A1 15-04-1971
			FR 1567219 A 16-05-1969
			GB 1163385 A 04-09-1969
			LU 53095 A1 29-11-1968
KR 101453218	B1	22-10-2014	NONE
WO 2016052931	A1	07-04-2016	KR 101585343 B1 13-01-2016
			WO 2016052931 A1 07-04-2016

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 2(completely); 1, 6-21(partially)

composition for the treatment of a keratinous substrate comprising a polycarbodiimide compound (cf. the formula in claim 2) and one or more amines; methods of application of said composition and a corresponding kit

2. claims: 3(completely); 1, 6-21(partially)

composition for the treatment of a keratinous substrate comprising a polycarbodiimide compound (cf. the formula in claim 3) and one or more amines; methods of application of said composition and a corresponding kit

3. claims: 4, 5(completely); 1, 6-21(partially)

composition for the treatment of a keratinous substrate comprising a polycarbodiimide compound (cf. the formula in claim 4) and one or more amines; methods of application of said composition and a corresponding kit
