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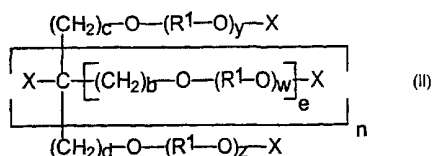
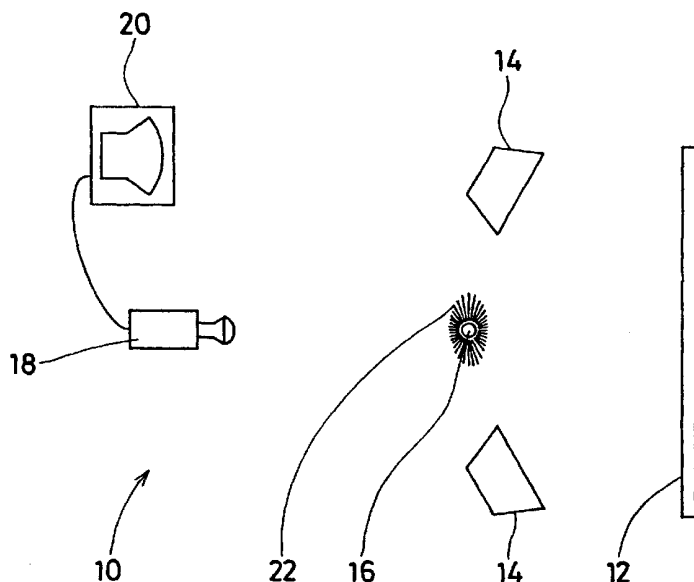
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(54) Title: HAIR CARE COMPOSITION AND METHOD OF USE THEREFOR



(57) Abstract: A hair care composition includes, by weight thereof, from about 0.01% to about 99% of an alkoxyate compound, from about 1% to about 99.99% of a suitable carrier, and the balance other additional components. The hair care composition reduces bulk hair area by at least about 10%, as measured by an Image Analysis Protocol. The alkoxyate compound has an HLB value of from about 5 to about 12, and is selected from a single-alkoxyate-chain segment polymer, a multi-alkoxyate-chain segment polymer, a cationic alkyl alkoxyate derivative, and mixtures thereof. The single-alkoxyate-chain segment polymer is of the formula (I):  $\text{X-O-(R}^1\text{O)}_a\text{-X}$ , where each X is independently selected from H, and  $\text{C}_1\text{-C}_{30}$  alkyl groups, each  $\text{R}^1$  is independently a  $\text{C}_2\text{-C}_4$  alkyl group, and a is a value from about 1 to about 400. The multi-alkoxyate-chain segment polymer is of formula (II), where X and  $\text{R}^1$  are defined as in Formula (I), n is a value from about 1 to about 10, each b is independently a value from about 0 to about 2, c and d are independently a value from about 0 to about 2,  $b + c + d$  is at least about 2, each e is independently a value of 0 or 1, and each w, y, and z is independently a value from about 1 to about 120. A method for reducing bulk hair area employs the hair care composition above.



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## HAIR CARE COMPOSITION AND METHOD OF USE THEREFOR

5

## FIELD OF THE INVENTION

10       The present invention relates to a hair treatment method and a hair care composition for treating hair.

## BACKGROUND OF THE INVENTION

15       Human hair becomes soiled due to its contact with the surrounding environment and from sebum secreted by the scalp. The soiling of the hair causes it to have a dirty or greasy feel, and an unattractive appearance. The soiling of the hair necessitates shampooing with regularity.

20       Shampooing cleans the hair by removing excess soil and sebum. However, shampooing can leave hair in a wet, tangled, and generally unmanageable state. After shampooing, hair is often left in a dry, rough, lusterless, or frizzy condition due to removal of the hair's natural oils and other natural conditioning components. Furthermore, such hair may also suffer from a perceived loss of softness. In addition, hair may possess increased levels of static after drying, which can interfere with combing and reduce hair manageability. This results in a condition commonly referred to as "flyaway hair."

25       Certain consumers consider such flyaway hair and the corresponding increase in total hair volume undesirable. Thus, it is desirable to provide smooth, soft, silky-feeling, and healthy-looking hair, while decreasing flyaway hair volume and total hair volume.

30       A variety of approaches have been developed to address these issues. Such approaches typically seek to increase smoothness, softness, and luster by

including hair conditioning compounds, typically cationic compounds, such as cationic surfactants, into a hair care composition. Such hair conditioning compounds may also reduce static. In theory, these cationic compounds, including quaternary ammonium compounds, seek to neutralize the static charge  
5 on the hair, and thus reduce flyaway hair volume. However, these hair conditioning compounds do not sufficiently reduce total hair volume, and may be harsh on the hair, skin, or scalp.

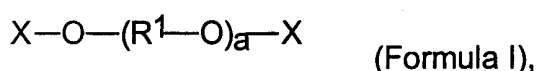
Alternatively, oily compounds, such as a silicone, an ester oil, and/or a hydrocarbon oil have been included in hair care compositions to reduce flyaway  
10 hair. However, while these oily compounds may make hair feel smoother, more silky, and/or appear more lustrous, they are not sufficient to satisfy certain consumers. Some styling compositions, such as gels, and mousses may reduce flyaway hair volume and total hair volume. However, such compositions typically reduce total hair volume by forming a "weld" (i.e., by cross-linking individual hairs  
15 together) and then hardening the hair with a film, or a hair-fixative polymer. Some consumers find such hair care compositions unacceptable, because they result in hair which is stiff and/or sticky. Other consumers may find such styling compositions unacceptable because they result in cross-linked hairs which are difficult to comb, or even uncombable once the weld sets. If the hair is combed,  
20 the styling benefits are significantly reduced or lost completely.

Accordingly, the need remains for a hair care composition which reduces total hair volume, while leaving the hair soft and combable. The need also remains for such a hair care composition which also provides smoother, silky, and lustrous hair. The need also remains for a hair care composition possessing  
25 these benefits, which is effectively deposited onto hair.

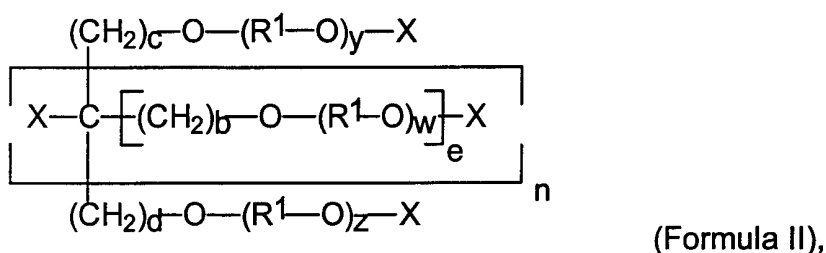
## SUMMARY OF THE INVENTION

The present invention relates to a hair care composition including, by weight of the hair care composition, from about 0.01% to about 99% of an  
30 alkoxylate compound, and from about 1% to about 99.99% of a suitable carrier, where the hair care composition reduces bulk hair area by at least about 10%, as

measured by an Image Analysis Protocol. The alkoxylate compound has an HLB value of from about 5 to about 12, and is selected from a single-alkoxylate-chain segment polymer, a multi-alkoxylate-chain segment polymer, a cationic alkyl alkoxylate derivative, and mixtures thereof. The single-alkoxylate-chain segment polymer is of the formula:



where each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>30</sub> alkyl groups, each R<sup>1</sup> is independently a C<sub>2</sub>-C<sub>4</sub> alkyl group, and a is a value from about 1 to about 400. The multi-alkoxylate-chain segment polymer is of the formula:



where X and R<sup>1</sup> are defined as in Formula I, n is a value from about 1 to about 10, each b is independently a value from about 0 to about 2, c and d are independently a value from about 0 to about 2, b + c + d is at least about 2, each e is independently a value of 0 or 1, and each w, y, and z is independently a value from about 1 to about 120. The present invention also relates to a method for employing such a hair care composition to reduce bulk hair area.

It has now been found that total hair volume is actually the sum of the "flyaway hair volume" and the "bulk hair volume." It has also been found that a measurable reduction of bulk hair area, flyaway hair area, and total hair area, by the Image Analysis Protocol described herein, corresponds to a noticeable decrease in the bulk hair volume, flyaway hair volume, and the total hair volume, respectively. Accordingly, it has been found that reducing the bulk hair area can therefore play a significant role in reducing the total hair volume. While certain compounds and compositions are known to reduce fly-away hair volume, for example, by reducing the static charge of hair, these compositions do not

noticeably reduce bulk hair volume. It has now been found that when applied to hair, a hair care composition as described herein may noticeably reduce bulk hair volume, and may also noticeably reduce flyaway hair volume. This, in turn, provides a significant, noticeable reduction in total hair volume.

5           It has now been found that when applied to hair, the hair care composition described herein may be inexpensive to formulate, easily biodegradable, easily deposited onto hair, and/or provide significant consumer-desirable benefits. Further, the hair care composition herein may provide improved smoothness, silkiness, and luster, while leaving the hair soft and easily combable.

10           These and other features, aspects, advantages, and variations of the present invention, and the embodiments described herein, will become evident to those skilled in the art from a reading of the present disclosure with the appended claims, and are covered within the scope of these claims.

#### 15                               BRIEF DESCRIPTION OF THE FIGURE

          While the specification concludes with claims particularly pointing out and distinctly claiming the invention, it is believed that the present invention will be better understood from the following description of preferred, nonlimiting embodiments and representations taken in conjunction with the accompanying  
20   drawings in which:

          Fig. 1 is a top view of a preferred embodiment of the Image Analysis System.

#### DETAILED DESCRIPTION OF THE INVENTION

25           All percentages, ratios and proportions herein are by weight of the final hair care composition, unless otherwise specified. All molecular weights herein are weight average molecular weights, unless otherwise specified. All temperatures are in degrees Celsius (°C) unless otherwise specified. All documents cited are incorporated herein by reference in their entireties. Citation  
30   of any reference is not an admission regarding any determination as to its

availability as prior art to the claimed invention. The figure herein is not necessarily drawn to scale.

As used herein, the term "alkyl" means a hydrocarbyl moiety which is straight, branched, or cyclic, saturated or unsaturated. Unless otherwise  
5 specified, alkyl moieties are preferably saturated or unsaturated with double bonds, preferably with one or two double bonds. Included in the term "alkyl" is the alkyl portion of acyl groups.

As used herein, the term "hair conditioning benefit" indicates a conditioning, softening, bulk hair volume reduction, flyaway hair volume  
10 reduction, total hair volume reduction, moisturizing, improved wet-hair or dry-hair feel, lubricating, smoothening, softening, and/or other effect when applied to hair. All reductions in bulk hair volume, flyaway hair volume, and/or total hair volume are according to the Image Analysis Protocol, as described herein.

As used herein, the term "water-insoluble" means the compound is  
15 substantially not soluble in water at 25 °C, when the compound is mixed with water at a concentration by weight of above 1.0%, preferably at above 0.5%, the compound is temporarily dispersed to form an unstable colloid in water, then is quickly separated from water into two phases.

As used herein, the term "CTFA" refers to the Cosmetic, Toiletry, and  
20 Fragrance Association, Inc.

#### ALKOXYLATE COMPOUND

The hair care composition of the present invention contains an alkoxyate compound selected from the group consisting of a single-alkoxyate-chain  
25 segment polymer, a multi-alkoxyate-chain segment polymer, a cationic alkyl alkoxyate derivative, and mixtures thereof. Without intending to be limited by theory, it is believed that an alkoxyate compound provides improved smoothness, silkiness, and luster, while leaving the hair soft and easily combable. It is believed that the alkoxyate compounds easily deposit onto  
30 and/or are absorbed by hair to act as a humectant. It is further believed that the oxygen groups of the alkoxyate hydrogen bond to water and deliver it to the hair

to provide moisturizing, and/or other desirable hair conditioning benefits. This moisturizes the hair and allows the hair to maintain a well-aligned conformation with respect to other hairs. This also allows the hair to remain in a soft, pliable and plastic state which allows it to easily recover from deformation, thereby increasing the likelihood that it will remain parallel, and/or hang straight down. This reduces the distance between the hairs, so as to significantly reduce bulk hair volume. By moisturizing the hair, the alkoxylate compound may also reduce the hair's static charge and crookedness. This in turn, reduces the electrostatic repulsion and space between hairs, which leads to a reduction in flyaway hair volume.

The alkoxylate compound herein has an HLB of from about 5 to about 12, preferably from about 6 to about 11, and more preferably from about 6 to about 10. Without intending to be limited by theory, it is believed that an alkoxylate compound having this HLB provides both acceptable moisturization benefits, while also easily depositing onto and/or absorbing into hair.

The HLB value is a theoretical index value which describes the hydrophilicity-hydrophobicity balance of a specific compound. Generally, it is recognized that the HLB index ranges from 0 (very hydrophobic) to 40 (very hydrophilic). The HLB value of the alkoxylate compounds and other compounds may be found in tables and charts known in the art, or may be calculated with the following general equation:  $HLB = 7 + \sum(\text{hydrophobic group values}) + \sum(\text{hydrophilic group values})$ . The HLB and methods for calculating the HLB of a compound are explained in detail in "Surfactant Science Series, Vol. 1: Nonionic Surfactants", pp. 606-13, M. J. Schick (Marcel Dekker, Inc., New York, 1966).

The alkoxylate compounds herein are typically polydisperse polymers. The alkoxylate compounds useful herein have a polydispersity of from about 1 to about 2.5, preferably from about 1 to about 2, and more preferably from about 1 to about 1.5. As used herein, the term "polydispersity" indicates the degree of the molecular weight distribution of the polymer sample. Specifically, the polydispersity is a ratio, greater than 1, equal to the weight average molecular weight divided by the number average molecular weight. For a further discussion



about polydispersity, see "Principles of Polymerization," pp. 20-24, G. Odian, (John Wiley & Sons, Inc., 3<sup>rd</sup> ed., 1991).

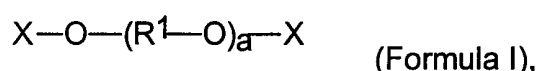
The alkoxylate compound useful herein may be either water-soluble, water-insoluble, or may have a limited solubility in water, depending upon the degree of polymerization and whether other moieties are attached thereto. The  
5 desired solubility of the alkoxylate compound in water will depend in large part upon the form (e.g., leave-on, or rinse-off form) of the hair care composition. The solubility in water of the alkoxylate compound herein may be chosen by the artisan according to a variety of factors. A water-soluble alkoxylate compound is  
10 especially useful in, for example, a leave-on product. Without intending to be limited by theory, it is believed that such a water-soluble alkoxylate compound may possess many advantages in such a product. For example, such a alkoxylate compound may be easy to formulate, inexpensive, highly biodegradable, and easily obtainable. Furthermore, water-soluble alkoxylate  
15 compounds may also provide a relatively higher moisturizing benefit, as they will typically attract more water molecules via hydrogen bonding. Accordingly, for a leave-on hair care composition, it is preferred that the alkoxylate compound herein be a water-soluble alkoxylate compound. Solubility information is readily available from alkoxylate compound suppliers, such as Sanyo Kasei (Osaka,  
20 Japan).

However, the present invention may also take the form of a rinse-off hair care composition. Without intending to be limited by theory, it is believed that in such a composition, a water-soluble alkoxylate compound may be too easily washed away before it effectively deposits on hair and provides the desired  
25 benefit(s). For such a composition, a less soluble, or even a water-insoluble alkoxylate compound is therefore preferred. Accordingly, for a rinse-off hair care composition, it is preferred that the alkoxylate compound herein has a solubility in water at 25 °C of less than about 1 g/100 g water, more preferably a solubility in water of less than about 0.5 g/100 g water, and even more preferably a solubility  
30 in water of less than about 0.1 g/100 g water.

The alkoxyate compound is typically present at a level of from about 0.01% to about 99%, preferably from about 0.1% to about 20%, and more preferably from about 0.2% to about 15%, by weight of the hair care composition.

#### 5 1. Single-Alkoxyate-Chain Segment Polymer

The single-alkoxyate-chain segment polymer useful herein has the formula:



wherein each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>30</sub> alkyl groups, preferably each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>22</sub> alkyl groups, and more preferably each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>18</sub> alkyl groups. X is branched, linear, or cyclic, and saturated or unsaturated, preferably, X is linear and saturated, or unsaturated having about one double bond. In Formula I, each R<sup>1</sup> is independently a C<sub>2</sub>-C<sub>4</sub> alkyl group, preferably, each R<sup>1</sup> is independently selected from the group consisting of a saturated C<sub>2</sub>H<sub>4</sub> group and a saturated C<sub>3</sub>H<sub>6</sub> group, and more preferably each R<sup>1</sup> is independently selected from the group consisting of a linear and saturated C<sub>2</sub>H<sub>4</sub> group and a linear and saturated C<sub>3</sub>H<sub>6</sub> group. In Formula I, a is a value from about 1 to about 400, preferably from about 2 to about 100, and more preferably from about 3 to about 40.

A preferred single-alkoxyate-chain segment polymer useful herein includes an alkyl alkoxyate, a single-polypropylene glycol-chain segment polymer, and mixtures thereof. Such single-alkoxyate-chain segment polymers are advantageous in that they are readily available, biodegradable, and easily absorbed into hair.

#### a. Alkyl Alkoxyate

The preferred alkyl alkoxyate useful herein includes compounds of Formula I, wherein a first X is H and a second X is a C<sub>1</sub>-C<sub>30</sub> alkyl group,

preferably the first X is H and the second X is a C<sub>6</sub>-C<sub>22</sub> alkyl group, and more preferably the first X is H and the second X is a C<sub>8</sub>-C<sub>18</sub> alkyl group. R<sup>1</sup> is defined as described above, and a is from about 1 to about 10, preferably from about 2 to about 8, and more preferably from about 3 to about 6. Without intending to be  
5 limited by theory, it is believed that these hydrophobic alkyl chains attach to the hair while the alkoxyate groups attract water molecules to the hair. This in turn moisturizes the hair and provides reduced bulk hair volume and even flyaway hair volume.

From a cost, availability, and performance standpoint, alkyl ethoxylates  
10 are especially preferred alkyl alkoxyates useful herein, and include, for example, by CTFA name: oleth-5, oleth-3, steareth-5, steareth-4, cetareth-5, cetareth-4, and cetareth-3, as well as mixtures of C<sub>9-11</sub>EO5, mixtures of C<sub>9-11</sub>EO2.5, mixtures of C<sub>12-13</sub>EO3, mixtures of C<sub>11-13</sub>EO5, and mixtures thereof. These alkyl ethoxylates are available from, for example, Croda, Inc. of Parsippany, New  
15 Jersey, USA; Shell Chemical of Houston, Texas, USA; BASF AG of Ludwigshafen, Germany; Mitsubishi Chemical of Tokyo, Japan; and Nikko Chemical of Tokyo, Japan. Such alkyl ethoxylates are especially preferred for use in rinse-off hair conditioning compositions.

20 b. Single-Polypropylene Glycol-Chain Segment Polymer

The single-polypropylene glycol-chain segment polymer useful herein includes compounds of Formula I wherein each X is H, at least one R<sup>1</sup> is a C<sub>3</sub>H<sub>6</sub> group, preferably at least about 50% of the R<sup>1</sup> groups are C<sub>3</sub>H<sub>6</sub> groups, more preferably at least about 75% of the R<sup>1</sup> groups are C<sub>3</sub>H<sub>6</sub> groups, and even more  
25 preferably substantially all of the R<sup>1</sup> groups are C<sub>3</sub>H<sub>6</sub> groups. The remaining R<sup>1</sup> groups may be selected from those described above in Formula I, preferably the remaining R<sup>1</sup> groups are C<sub>2</sub>H<sub>4</sub> groups. For the single-polypropylene glycol-chain segment polymer, a is a value from about 4 to about 400, preferably from about 20 to about 100, and more preferably from about 20 to about 40. Although it is  
30 dependent upon the polydispersity of the actual single-polypropylene glycol-chain segment polymer preparation, such a preparation typically has a weight average

molecular weight of from about 200 g/mol to about 30,000 g/mol, preferably of from about 1,000 g/mol to about 10,000 g/mol, and more preferably from about 2,000 g/mol to about 8,000 g/mol.

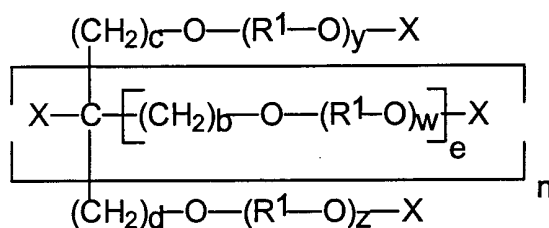
Without intending to be limited by theory, it is believed that once it has deposited onto a strand of hair, the shape and relatively small size of the single-polypropylene glycol-chain segment polymer herein allows it to easily penetrate the hair. While useful for both a leave-on and a rinse-off form, a single-polypropylene glycol-chain segment polymer is especially preferred if the hair care composition is to take a leave-on form. Furthermore, the multiple alkylene oxide groups attract a significant amount of water and maintain it in close proximity to the hair so as to impart significant moisturization properties. This increased moisturization results in reduced flyaway hair volume, reduced bulk hair volume, and/or increases the manageability of the hair.

In a preferred embodiment, one or more of the propylene oxide groups in the polypropylene glycol is an isopropyl oxide repeating group. More preferably, substantially all of the  $R^1$  groups of Formula I are isopropyl oxide repeating groups.

The single-polypropylene glycol-chain segment polymer useful herein is typically inexpensive, and is readily available from, for example, Sanyo Kasei (Osaka, Japan), Dow Chemicals (Midland, Michigan, USA), Calgon Chemical, Inc. (Skokie, Illinois, USA), Arco Chemical Co. (Newton Square Pennsylvania, USA), Witco Chemicals Corp. (Greenwich, Connecticut, USA), and PPG Specialty Chemicals (Gurnee, Illinois, USA). Another preferred single-polypropylene glycol-chain segment polymer useful herein is PPG-10 butanediol (each  $X = H$ ,  $a = 11$ , and each  $R^1 = C_3H_6$ , except for one non-terminal  $R^1$  which is  $C_4H_8$ ; available as Probutyl DB-10, from Croda, Inc., of Parsippany, New Jersey, U.S.A.).

## 2. Multi-Alkoxyate-Chain Segment Polymer

The multi-alkoxyate-chain segment polymer useful herein has the formula:



(Formula II),

wherein each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>30</sub> alkyl groups, preferably each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>22</sub> alkyl groups, and more preferably each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>4</sub> alkyl groups. X is branched or linear, and saturated or unsaturated, preferably X is linear and saturated, or unsaturated having about one double bond. In Formula II, each R<sup>1</sup> is independently a C<sub>2</sub>-C<sub>4</sub> alkyl group, preferably, each R<sup>1</sup> is independently selected from the group consisting of a saturated C<sub>2</sub>H<sub>4</sub> group and a saturated C<sub>3</sub>H<sub>6</sub> group, and more preferably each R<sup>1</sup> is independently selected from the group consisting of a linear and saturated C<sub>2</sub>H<sub>4</sub> group and a linear and saturated C<sub>3</sub>H<sub>6</sub> group.

In Formula II, n is a value from about 1 to about 10, preferably from about 1 to about 7, and more preferably from about 1 to about 4. In Formula II, each b is independently a value from about 0 to about 2, preferably from about 0 to about 1, and more preferably b = 0. Similarly, c and d are independently a value from about 0 to about 2, preferably from about 0 to about 1. However, the total of b + c + d is at least about 2, preferably the total of b + c + d is from about 2 to about 3. In Formula II, each e is independently a value of 0 or 1, if n is from about 1 to about 4, then e is preferably equal to 1. Also in Formula II, each w, y, and z is independently a value of from about 7 to about 120, preferably each w, y, and z is independently a value of from about 7 to about 120, where w + y + z is greater than about 20, and more preferably each w, y, and z is independently a value of from about 7 to about 120, where w + y + z is from about 20 to about 600.

The weight average molecular weight of the multi-alkoxylate-chain segment polymer useful herein is highly dependent upon, for example, n, R<sup>1</sup>, X,

e, the polydispersity of the actual multi-polypropylene glycol-chain segment polymer preparation, etc. However, the multi-alkoxylate-chain segment polymer preparation useful herein typically has a weight average molecular weight of from about 4,000 to about 120,000 g/mol, preferably of from about 4,000 to about 5 70,000 g/mol.

The general structure of branched polymers such as the multi-alkoxylate-chain segment polymers herein are described, for example, in "Principles of Polymerization," pp. 17-19, G. Odian, (John Wiley & Sons, Inc., 3<sup>rd</sup> ed., 1991). Without intending to be limited by theory, it is believed that the multi-alkoxylate-  
10 chain segment polymer efficiently deposits onto hair, due to the combination of high molecular weight, HLB, and bulkiness. As they are typically less soluble in water than the alkoxylate compounds of Formula II, the multi-alkoxylate-chain segment polymers of Formula II are especially preferred in a rinse-off hair care composition. As with the compounds of Formula I, it is believed that the multiple  
15 alkylene oxide groups attract a significant amount of water and maintain it in close proximity to the hair so as to impart significant moisturization properties. This increased moisturization results in reduced flyaway hair volume, reduced bulk hair volume, and/or increases the manageability of the hair.

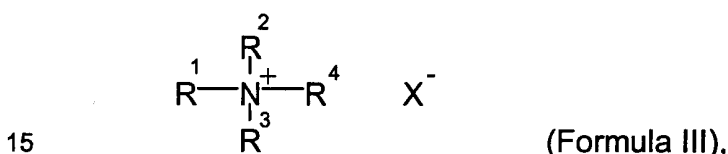
In a preferred embodiment, the multi-alkoxylate-chain segment polymer is  
20 a multi-polypropylene glycol-chain segment polymer wherein one or more of the R<sup>1</sup> groups in the multi-alkoxylate-chain segment polymer is a C<sub>3</sub>H<sub>6</sub> group, preferably at least about 50% of the R<sup>1</sup> groups are C<sub>3</sub>H<sub>6</sub> groups, more preferably at least about 75% of the R<sup>1</sup> groups are C<sub>3</sub>H<sub>6</sub> groups, and even more preferably substantially all of the R<sup>1</sup> groups are C<sub>3</sub>H<sub>6</sub> groups. The remaining R<sup>1</sup> groups may  
25 be selected from those described above in Formula I, preferably the remaining R<sup>1</sup> groups are C<sub>2</sub>H<sub>4</sub> groups. It is also preferred that one or more of the R<sup>1</sup> groups in Formula II be an isopropyl oxide group. Even more preferably, substantially all of the R<sup>1</sup> groups of Formula II are isopropyl oxide groups.

Examples of preferred multi-alkoxylate-chain segment polymers of  
30 Formula II which is especially useful herein includes polyoxypropylene glyceryl ether (n = 1, each X = H, each R<sup>1</sup> = C<sub>3</sub>H<sub>6</sub>, b = 0, c and d = 1, e = 1, and w, y, and

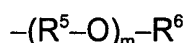
z independently indicate the degree of polymerization of their respective polypropylene glycol-chain segments; available as New Pol GP-4000, from Sanyo Kasei, Osaka, Japan), polypropylene trimethylol propane ( $n = 1$ , each  $X = H$ , except for the  $X$  attached to the central carbon, which is  $C_2H_5$ , each  $R^1 = C_3H_6$ ,  $b = 1$ ,  $c$  and  $d = 1$ ,  $e = 1$ , and  $w$ ,  $y$ , and  $z$  independently indicate the degree of polymerization of their respective polypropylene glycol-chain segments), polyoxypropylene sorbitol ( $n = 4$ , each  $X = H$ , each  $R^1 = C_3H_6$ ,  $b = 0$ ,  $c$  and  $d = 1$ , each  $e = 1$ , and  $y$ ,  $z$ , and each  $w$  independently indicate the degree of polymerization of their respective polypropylene glycol-chain segments; available as New Pol SP-4000, from Sanyo Kasei, Osaka, Japan).

### 3. Cationic Alkyl Alkoxyate Derivative

The cationic alkyl alkoxyate derivative useful herein has the following formula:



wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$  or  $R^4$  is independently an alkyl alkoxyate group having the following formula:



wherein  $R^5$  is independently a linear, branched, cyclic, saturated, or unsaturated alkyl group having 1 to about 8 carbons;  $R^6$  is a linear, branched, cyclic, saturated, or unsaturated alkyl group having 1 to about 30 carbons; and  $m$  is an integer of 1 to about 100;

wherein at least one of  $R^1$ ,  $R^2$ ,  $R^3$  or  $R^4$  is independently a hydroxyalkyl group having the following formula:



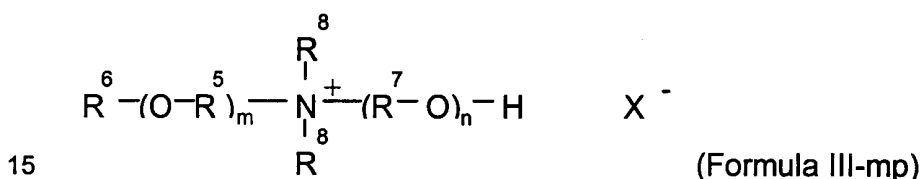
wherein  $R^7$  is independently a linear, branched, cyclic, saturated, or unsaturated alkyl group having 1 to about 8 carbons; and  $n$  is an integer of 1 to about 100;

wherein the remainder of R<sup>1</sup>, R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> is independently R<sup>8</sup> which is a linear, branched, cyclic, saturated, or unsaturated alkyl having 1 to about 30 carbons; and

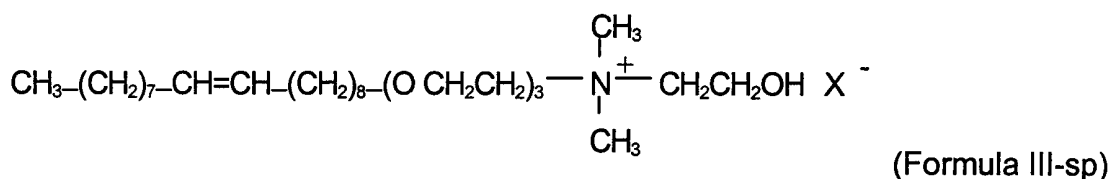
X is selected from the group consisting of chloride, bromide, iodide, sulfate, hydrosulfate, methylsulfate, ethylsulfate, carbonate, hydrocarbonate, and mixtures thereof.

Preferably, R<sup>8</sup> is an alkyl having 1 to about 4 carbons, R<sup>6</sup> is a branched or unsaturated alkyl having 6 to about 22 carbons, R<sup>5</sup> and R<sup>7</sup> are independently an alkyl having 2 or 3 carbons, and m and n are independently an integer of 1 to about 10.

Preferably, the cationic alkyl alkoxyate derivatives of the present invention have only one alkyl alkoxyate group. More preferably, the cationic alkyl alkoxyate derivatives of the present invention have only one alkyl alkoxyate group, only one hydroxyalkyl group, and two alkyl groups, as follows:



Still preferred is a cationic alkyl alkoxyate derivative having the following formula:



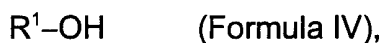
## 20 Synthesis of Cationic Alkyl Alkoxyate Derivative

The cationic alkyl alkoxyate derivative herein can be prepared by a process comprising four steps.

### i. Starting Material

The first step comprises providing a starting material having the following formula:

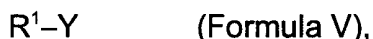




wherein  $R^1$  is the alkyl alkoxylate group represented by  $-(R^5-O)_m-R^6$  described above, the hydroxyalkyl group represented by  $-(R^7-O)_n-H$  described above, or  $R^8$ . Preferably,  $R^1$  is the alkyl alkoxylate group.

5    ii. Activation

The second step comprises activation of the starting material having Formula IV with an activating agent. The activation is executed to form a compound having the following formula:



10    wherein Y is a halide or OZ wherein Z is a sulfonyl group.

The halide can be a chloride, bromide, iodide, or mixture thereof. The halide can be derived from an activating agent selected from the group consist of  $SOCl_2$ ,  $PCl_5$ ,  $PCl_3$ , and  $POCl_3$  (in the case of chlorination),  $PBr_3$ ,  $PBr_5$ ,  $SOBr_2$ , and  $HBr$  (in the case of bromination),  $HI$ ,  $I_2$  (in the case of iodination), and mixtures thereof. The sulfonyl group can be derived from an activating agent which is a sulfonyl halide selected from the group consisting of tosyl halide (para-toluene sulfonyl halide), mesyl halide (methane sulfonyl halide), trifluoromethane sulfonyl halide, nosyl halide (para-nitrobenzene sulfonyl halide), brosyl halide (para-bromobenzene sulfonyl halide), 2,2,2-trifluoroethane sulfonyl halide, and mixtures thereof; wherein halide is chloride, bromide, iodide, or mixture thereof. A preferable sulfonyl halide is tosyl chloride, mesyl chloride, and mixtures thereof.

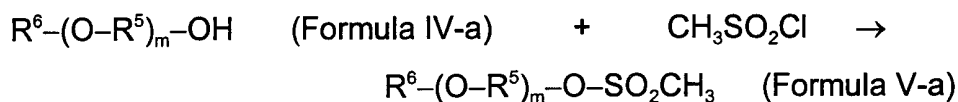
The Y groups, such as the halide or the OZ wherein Z is the sulfonyl group, are preferable leaving groups, thus, the compound having Formula V is utilized for the synthetic process including the next nucleophilic substitution.

Preferably, in the activation step of the present invention, Y is OZ wherein Z is the sulfonyl group, and the activation of the starting material is executed with the sulfonyl halide as the activating agent for forming the compound having the following formula:



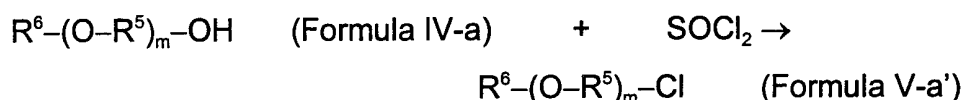
wherein Z is the sulfonyl group, preferably, tosyl or mesyl group.

An embodiment of the activation step using mesyl chloride as the activating agent is shown in the following scheme:



The starting material as exemplified by Formula IV-a is subjected to the reaction with an activating agent to obtain a compound as shown by Formula V-a. Preferably, sulfonyl halides are used as the activating agent in the activation step of the present invention, more preferably, tosyl chloride or mesyl chloride.

Another embodiment of the activation using sulfinyl chloride as the activating agent is shown in the following scheme:



The starting material as exemplified by Formula IV-a is subjected to the reaction with an activating agent as exemplified by sulfinyl chloride to obtain a compound as shown by Formula V-a'.

Suitable mediums for carrying out this first step of synthesis include inert solvents which provide an anhydrous condition. Exemplary inert solvents are absolute (hereinafter referred to as "abs.") tetrahydrofuran (hereinafter referred to as "THF"), abs. benzene, abs. toluene, abs. triethylamine, abs. pyridine, and mixtures thereof. Preferably, the medium contains a Lewis base. Exemplary Lewis bases include those which are liquid and solid such as abs. triethylamine, abs. pyridine, dimethylamino pyridine (hereinafter referred to as "DMAP"), and 1,8-diazabicyclo[5.4.0.]7-undecene (hereinafter referred to as "DBU"). Abs. triethylamine and abs. pyridine act both as a solvent and a liquid Lewis base, and thus are suitable. Abs. triethylamine is a highly suitable liquid Lewis base. More preferably, the medium contains at least a stoichiometric amount to the activating agent of a Lewis base, as it provides good yield. Still preferably, the medium contains: a volatile solvent such as abs. THF, abs. benzene, abs. toluene and mixtures thereof; and a stoichiometric amount to the activating agent of a liquid Lewis base such as abs. triethylamine, abs. pyridine, and mixtures

thereof. The reaction can be carried out at room temperature and at atmospheric pressure.

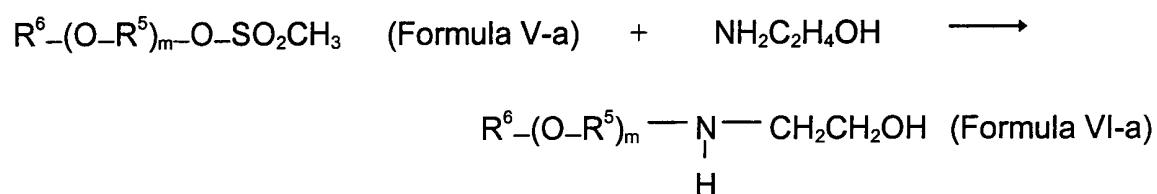
### iii. Nucleophilic Substitution

The third step comprises nucleophilic substitution of the compound having  
 5 Formula V formed in the above activation step. The nucleophilic substitution is executed with a nitrogen containing nucleophile comprising R<sup>4</sup> and R<sup>9</sup> groups to form a compound having the following formula:



wherein R<sup>4</sup> is the alkyl alkoxylate group represented by  $-(\text{R}^5-\text{O})_m-\text{R}^6$  described  
 10 above, the hydroxyalkyl group represented by  $-(\text{R}^7-\text{O})_n-\text{H}$  described above, or R<sup>8</sup>; and R<sup>9</sup> is hydrogen or R<sup>3</sup> selected from the alkyl alkoxylate group, the hydroxyalkyl group, or R<sup>8</sup>. Preferably, R<sup>4</sup> is the hydroxyalkyl group, and R<sup>9</sup> is hydrogen.

An embodiment of the nucleophilic substitution step is shown in the  
 15 following scheme:



The compound as exemplified by Formula V-a is subjected to the reaction with the nitrogen containing nucleophile comprising R<sup>4</sup> and R<sup>9</sup> groups to obtain a compound of Formula VI-a. The nucleophile containing a nitrogen and  
 20 comprising R<sup>4</sup> and R<sup>9</sup> can be a tertiary amine which comprises at least one group selected from the alkyl alkoxylate group, the hydroxyalkyl group, or R<sup>8</sup>, and one or two hydrogens. Preferable nucleophiles are those comprising only one hydroxyalkyl group and two hydrogens, for example, ethanolamine shown in above scheme.

25 Suitable mediums for carrying out this nucleophilic substitution step include inert solvents which are more polar than those disclosed above as

"suitable mediums" under the title "Activation". Exemplary insert solvents are ethanol, methanol, propanol, water, and mixtures thereof.

#### iv. Quaternization

The fourth step comprises quaternization of the compound having the Formula VI formed in the above nucleophilic substitution step. The quaternization is executed to form a compound having the Formula III which is disclosed above under the title "Cationic Alkyl Alkoxylate Derivative".

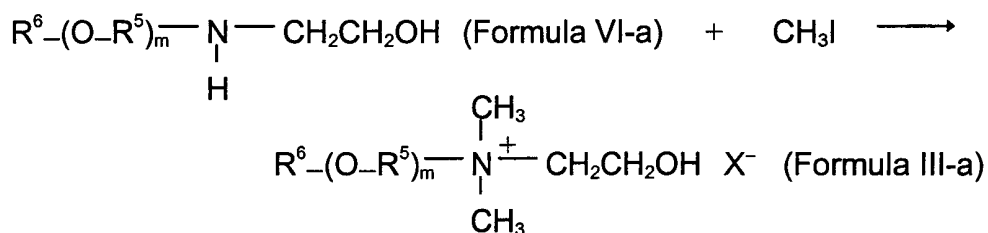
Formula III is as follows:



wherein  $\text{R}^2$  and  $\text{R}^3$  are independently the alkyl alkoxylate group, the hydroxyalkyl group, or  $\text{R}^8$ . Preferably,  $\text{R}^2$  and  $\text{R}^3$  are independently  $\text{R}^8$ .

This reaction can be carried out by adding a quaternizing agent. Quaternizing agents provide the  $\text{R}^2$  group shown in the Formula III, and may also provide the  $\text{R}^3$  group shown in the Formula III when  $\text{R}^9$  of Formula VI is hydrogen. When  $\text{R}^9$  is hydrogen,  $\text{R}^3$  is preferably the same as  $\text{R}^2$ . Quaternizing agents can be selected from the group consisting of alkyl sulfates which have the  $\text{R}^2$  group or may have the  $\text{R}^3$  group, alkyl halides which have the  $\text{R}^2$  group or may have the  $\text{R}^3$  group, and mixtures thereof, wherein halide is chloride, bromide, iodide, and mixtures thereof. Preferable quaternizing agents are those which provide the alkyl group  $\text{R}^8$  in the position of  $\text{R}^2$  or  $\text{R}^3$ . For example, methyl iodide shown in below scheme provides a methyl group. It is known in the art that, when quaternization is conducted with quaternizing agents which provide positively charged alkyls, the quaternized cite is stable and pH independent.

An embodiment of quaternization step using methyl iodide as the quaternizing agent is shown in the following scheme:



Suitable mediums for carrying out this quaternization step include inert solvents which are selected from the species disclosed above as "suitable mediums" under the title "Nucleophilic Substitution".

5

### SUITABLE CARRIER

The hair care composition contains from about 1% to about 99.99%, preferably from about 50% to about 95% of a suitable carrier. The suitable carrier contains a continuous phase, which is typically either water, or oil. The continuous phase is preferably water, but even a water continuous phase may also contain an oil emulsified, or dispersed therein, and visa-versa. Other carrier ingredients and/or other additional components may also be added into the suitable carrier.

#### 15 1. Water

The final hair care composition of the present invention typically comprises at least about 60%, preferably at least about 70% water, and more preferably from about 75% to about 95% water. Deionized water is preferably used. Water from natural sources including mineral cations may also be used, depending on the desired characteristic of the product. The level and species of the suitable carrier are selected according to the compatibility with other components, and other desired characteristics of the product.

The suitable carrier may also include therein a lower alkyl alcohol, a polyhydric alcohol, and a mixture thereof. Lower alkyl alcohols useful herein are monohydric alcohols having 1 to 6 carbons, more preferably ethanol and isopropanol. The preferred polyhydric alcohols useful herein include propylene glycol, hexylene glycol, glycerin, and propane diol.

In a preferred embodiment, the suitable carrier is in the form of a gel matrix containing a cationic surfactant, a solid fatty alcohol, and water, and is typically characterized by a high viscosity of from about 5,000 cps to about 40,000 cps, preferably from about 10,000 cps to about 30,000 cps, and more preferably from about 12,000 cps to about 28,000 cps, as measured at 25 °C, by means of a Brookfield Viscometer at shear rate of 1.0 rpm. If present, the gel matrix comprises from about 60% to about 99%, preferably from about 70% to about 95%, and more preferably from about 80% to about 95%, by weight of the hair care composition.

In a highly preferred embodiment, the gel matrix is preferably a lamellar gel matrix, which provides improved deposition, wet hair feel, softness, and other substantial benefits. In a lamellar gel matrix, the weight ratio of cationic surfactant to solid fatty compound is from about 1:1 to about 1:20, preferably from about 1:2 to about 1:10, and more preferably from about 1:3 to 1:5. Generally, the preferred cationic surfactants in the lamellar gel matrix contain one or two long chain (e.g., C<sub>12-30</sub>) alkyl groups, and a tertiary or quaternary amine group. Tertiary amine groups having one or two C<sub>16-22</sub> alkyl chains are preferred.

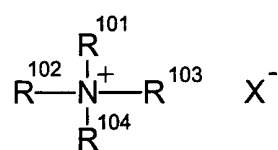
The existence of a lamellar gel matrix may be detected by differential scanning calorimetry (hereinafter referred to as "DSC") measurement of the composition. A profile chart obtained by DSC measurement describes chemical and physical changes of the scanned sample that involve an enthalpy change or energy gradient when the temperature of the sample is fluctuated. As such, the phase behavior and interaction among components of hair conditioning compositions of the present invention may be understood by their DSC profiles. DSC measurement of compositions of the present invention may be conducted by any suitable instrument available. For example, DSC measurement may be suitably conducted by Seiko DSC 6000 instrument available from Seiko Instruments Inc. In a typical measurement procedure, a sample is prepared by sealing an appropriate amount of the composition into a container made for DSC measurement and sealed. The weight of the sample is recorded. A blank sample i.e.; an unsealed sample of the same container is also prepared. The

sample and blank sample are placed inside the instrument, and run under a measurement condition of from about -50 °C to about 130 °C at a heating rate of from about 1 °C/minute to about 10 °C/minute. The area of the peaks as identified are calculated and divided by the weight of the sample to obtain the  
 5 enthalpy change in mJ/mg.

In a preferred lamellar gel matrix, the DSC profile shows a formation peak of larger than about 3 mJ/mg. The position of the peaks are identified by the peak top position. The DSC profile of the preferred lamellar gel matrix shows a single peak having a peak top temperature of from about 55 °C to about 75 °C,  
 10 and from about 6 mJ/mg to about 10 mJ/mg, and no peaks larger than 3 mJ/mg from 40 °C to 55 °C. It is believed that a composition formed predominantly with such a lamellar gel matrix shows a relatively stable phase behavior during the temperature range of from about 40 °C to about 55 °C. In an even more preferred lamellar gel matrix, the DSC profile shows a single peak having a peak  
 15 top temperature of about 69 °C, at about 8 mJ/mg, and no peaks larger than 3 mJ/mg from 40 °C to about 65 °C.

#### a. Cationic Surfactant

Among the cationic surfactants useful herein are those corresponding to  
 20 the general Formula VII:



(Formula VII)

wherein at least one of R<sup>101</sup>, R<sup>102</sup>, R<sup>103</sup> and R<sup>104</sup> is selected from an aliphatic group of from 8 to 30 carbon atoms or an aromatic, alkoxy, polyoxyalkylene, alkylamido, hydroxyalkyl, aryl or alkylaryl group having up to about 22 carbon  
 25 atoms, the remainder of R<sup>101</sup>, R<sup>102</sup>, R<sup>103</sup> and R<sup>104</sup> are independently selected from an aliphatic group of from 1 to about 22 carbon atoms or an aromatic, alkoxy, polyoxyalkylene, alkylamido, hydroxyalkyl, aryl or alkylaryl group having up to about 22 carbon atoms; and X<sup>-</sup> is a salt-forming anion such as those selected

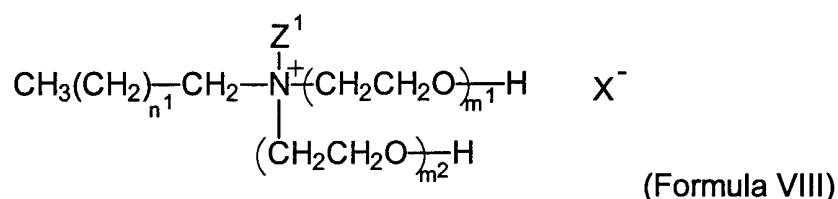
from halogen (e.g., chloride, bromide), acetate, citrate, lactate, glycolate, phosphate, nitrate, sulfonate, sulfate, alkylsulfate, and alkyl sulfonate radicals. The aliphatic groups can contain, in addition to carbon and hydrogen atoms, ether linkages, and other groups such as amino groups. The longer chain  
5 aliphatic groups, e.g., those of about 12 carbons, or higher, can be saturated or unsaturated. Preferred is when  $R^{101}$ ,  $R^{102}$ ,  $R^{103}$  and  $R^{104}$  are independently selected from  $C_1$  to about  $C_{22}$  alkyl. Nonlimiting examples of cationic surfactants useful in the present invention include the materials having the following CTFA designations: quaternium-8, quaternium-14, quaternium-18, quaternium-18  
10 methosulfate, quaternium-24, and mixtures thereof.

Among the cationic surfactants of general Formula VII, preferred are those containing in the molecule at least one alkyl chain having at least 16 carbons. Nonlimiting examples of such preferred cationic surfactants include: behenyl trimethyl ammonium chloride available, for example, with tradename  
15 INCROQUAT TMC-80 from Croda and ECONOL TM22 from Sanyo Kasei; cetyl trimethyl ammonium chloride available, for example, with tradename CA-2350 from Nikko Chemicals (Tokyo, Japan), hydrogenated tallow alkyl trimethyl ammonium chloride, dialkyl (14-18) dimethyl ammonium chloride, ditallow alkyl dimethyl ammonium chloride, dihydrogenated tallow alkyl dimethyl ammonium  
20 chloride, distearyl dimethyl ammonium chloride, dicetyl dimethyl ammonium chloride, di(behenyl/arachidyl) dimethyl ammonium chloride, dibehenyl dimethyl ammonium chloride, stearyl dimethyl benzyl ammonium chloride, stearyl propyleneglycol phosphate dimethyl ammonium chloride, stearyl amidopropyl dimethyl benzyl ammonium chloride, stearyl amidopropyl dimethyl  
25 (myristylacetate) ammonium chloride, and N-(stearyl colamino formyl methyl) pyridinium chloride.

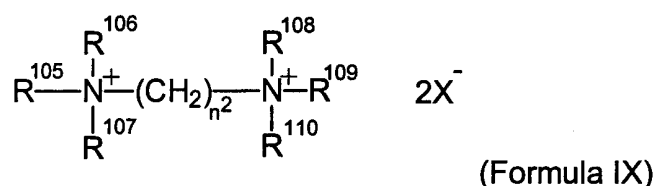
Also preferred as cationic surfactants are hydrophilically substituted cationic surfactants in which at least one of the substituents contain one or more aromatic, ether, ester, amido, or amino moieties present as substituents or as  
30 linkages in the radical chain, wherein at least one of the  $R^{101}$ - $R^{104}$  radicals contain one or more hydrophilic moieties selected from alkoxy (preferably  $C_1$ - $C_3$  alkoxy),



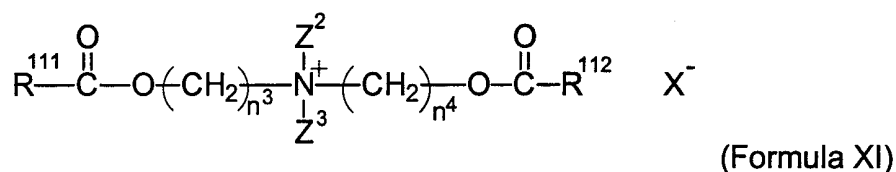
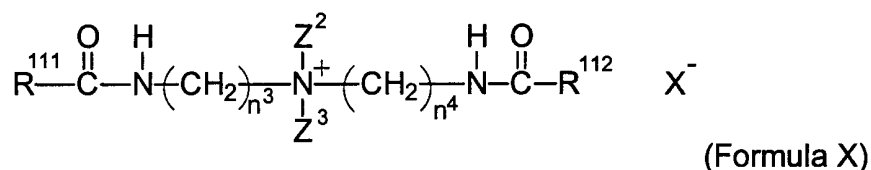
polyoxyalkylene (preferably C<sub>1</sub>-C<sub>3</sub> polyoxyalkylene), alkylamido, hydroxyalkyl, alkylester, and combinations thereof. Preferably, the hydrophilically substituted cationic surfactant contains from 2 to about 10 nonionic hydrophile moieties located within the above stated ranges. Preferred hydrophilically substituted cationic surfactants include those of Formulas VIII through XIV below:



wherein n<sup>1</sup> is from 8 to about 28, m<sup>1</sup>+m<sup>2</sup> is from 2 to about 40, Z<sup>1</sup> is a short chain alkyl, preferably a C<sub>1</sub>-C<sub>3</sub> alkyl, more preferably methyl, or (CH<sub>2</sub>CH<sub>2</sub>O)<sub>m<sup>3</sup></sub>H wherein m<sup>1</sup>+m<sup>2</sup>+m<sup>3</sup> is up to 60, and X<sup>-</sup> is a salt-forming anion as defined above;

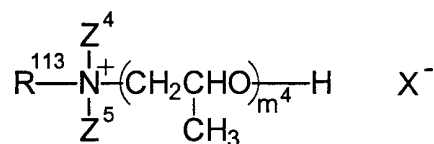


wherein n<sup>2</sup> is 1 to 5, one or more of R<sup>105</sup>, R<sup>106</sup>, and R<sup>107</sup> are independently an C<sub>1</sub>-C<sub>30</sub> alkyl, the remainder are CH<sub>2</sub>CH<sub>2</sub>OH, one or two of R<sup>108</sup>, R<sup>109</sup>, and R<sup>110</sup> are independently an C<sub>1</sub>-C<sub>30</sub> alkyl, and remainder are CH<sub>2</sub>CH<sub>2</sub>OH, and X<sup>-</sup> is a salt-forming anion as mentioned above;



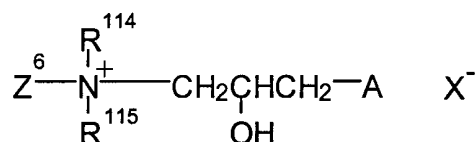
wherein, independently for Formulas X and XI, Z<sup>2</sup> is an alkyl, preferably C<sub>1</sub>-C<sub>3</sub> alkyl, more preferably methyl, and Z<sup>3</sup> is a short chain hydroxyalkyl, preferably hydroxymethyl or hydroxyethyl, n<sup>3</sup> and n<sup>4</sup> independently are integers from 2 to 4, inclusive, preferably from 2 to 3, inclusive, more preferably 2, R<sup>111</sup> and R<sup>112</sup>,

independently, are substituted or unsubstituted hydrocarbyls, C<sub>12</sub>-C<sub>20</sub> alkyl or alkenyl, and X<sup>-</sup> is a salt-forming anion as defined above;



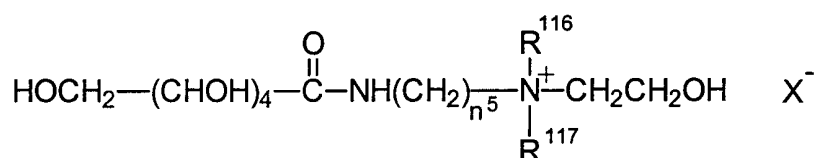
(Formula XII)

wherein R<sup>113</sup> is a hydrocarbyl, preferably a C<sub>1</sub>-C<sub>3</sub> alkyl, more preferably methyl, Z<sup>4</sup> and Z<sup>5</sup> are, independently, short chain hydrocarbyls, preferably C<sub>2</sub>-C<sub>4</sub> alkyl or alkenyl, more preferably ethyl, m<sup>4</sup> is from 2 to about 40, preferably from about 7 to about 30, and X<sup>-</sup> is a salt-forming anion as defined above;



(Formula XIII)

wherein R<sup>114</sup> and R<sup>115</sup>, independently, are C<sub>1</sub>-C<sub>3</sub> alkyl, preferably methyl, Z<sup>6</sup> is a C<sub>12</sub>-C<sub>22</sub> hydrocarbyl, alkyl carboxy or alkylamido, and A is a protein, preferably a collagen, keratin, milk protein, silk, soy protein, wheat protein, or hydrolyzed forms thereof; and X<sup>-</sup> is a salt-forming anion as defined above;



(Formula XIV)

wherein n<sup>5</sup> is 2 or 3, R<sup>116</sup> and R<sup>117</sup>, independently are C<sub>1</sub>-C<sub>3</sub> hydrocarbyls preferably methyl, and X<sup>-</sup> is a salt-forming anion as defined above. Nonlimiting examples of hydrophilically substituted cationic surfactants useful in the present invention include the materials having the following CTFA designations: quaternium-16, quaternium-26, quaternium-27, quaternium-30, quaternium-33, quaternium-43, quaternium-52, quaternium-53, quaternium-56, quaternium-60, quaternium-61, quaternium-62, quaternium-70, quaternium-71, quaternium-72, quaternium-75, quaternium-76 hydrolyzed collagen, quaternium-77, quaternium-78, quaternium-79 hydrolyzed collagen, quaternium-79 hydrolyzed keratin,

quaternium-79 hydrolyzed milk protein, quaternium-79 hydrolyzed silk, quaternium-79 hydrolyzed soy protein, and quaternium-79 hydrolyzed wheat protein, quaternium-80, quaternium-81, quaternium-82, quaternium-83, quaternium-84, and mixtures thereof.

5        Highly preferred hydrophilically substituted cationic surfactants include dialkylamido ethyl hydroxyethylmonium salt, dialkylamidoethyl dimonium salt, dialkyloyl ethyl hydroxyethylmonium salt, dialkyloyl ethyldimonium salt, and mixtures thereof; for example, commercially available under the following tradenames; VARISOFT 110, VARISOFT 222, VARIQUAT K1215 and  
 10        VARIQUAT 638 from Witco Chemicals (Greenwich, Connecticut, USA), MACKPRO KLP, MACKPRO WLW, MACKPRO MLP, MACKPRO NSP, MACKPRO NLW, MACKPRO WWP, MACKPRO NLP, MACKPRO SLP from McIntyre, ETHOQUAD 18/25, ETHOQUAD O/12PG, ETHOQUAD C/25, ETHOQUAD S/25, and ETHODUOQUAD from Akzo, DEHYQUAT SP from  
 15        Henkel (Germany), and ATLAS G265 from ICI Americas (Wilmington, Delaware, USA).

Salts of primary, secondary, and tertiary fatty amines are also suitable cationic surfactants. The alkyl groups of such amines preferably have from about 12 to about 22 carbon atoms, and can be substituted or unsubstituted.  
 20        Particularly useful are amido substituted tertiary fatty amines. Such amines, useful herein, include stearamidopropyldimethylamine, stearamidopropyldiethylamine, stearamidoethyldiethylamine, palmitamidopropyldimethylamine, palmitamidopropyldiethylamine, palmitamidoethyldiethylamine, behenamidopropyldimethylamine, behenamidopropyldiethylamine, behenamidoethyldiethylamine, behenamidoethyldimethylamine, arachidamidopropyldimethylamine, arachidamidopropyldiethylamine, arachidamidoethyldiethylamine, diethylaminoethylstearamide. Also useful are  
 25        dimethylstearamine, dimethylsoyamine, soyamine, myristylamine, tridecylamine, ethylstearylamine, N-tallowpropane diamine, ethoxylated (with 5 moles of

ethylene oxide) stearylamine, dihydroxyethylstearylamine, and arachidylbehenylamine. These amines are typically used in combination with an acid to provide the cationic species. The preferred acid useful herein includes L-glutamic acid, lactic acid, hydrochloric acid, malic acid, succinic acid, acetic acid, fumaric acid, tartaric acid, citric acid, L-glutamic hydrochloride, and mixtures thereof; more preferably L-glutamic acid, lactic acid, citric acid. Cationic amine surfactants included among those useful in the present invention are disclosed in U.S. Patent 4,275,055 to Nachtigal, et al., issued June 23, 1981.

The molar ratio of protonatable amines to  $H^+$  from the acid is preferably from about 1:0.3 to 1:1.2, and more preferably from about 1:0.5 to about 1:1.1.

**b. Solid Fatty Compound**

The solid fatty compound useful herein has a melting point of 25 °C or higher, and is selected from the group consisting of fatty alcohols, fatty acids, and mixtures thereof. It is understood by the artisan that the compounds disclosed in this section of the specification can in some instances fall into more than one classification, e.g., some fatty alcohol derivatives may also be classified as fatty acid derivatives. However, a given classification is not intended to be a limitation on that particular compound, but is done so for convenience of classification and nomenclature. Further, it is understood by the artisan that, depending on the number and position of double bonds, and length and position of the branches, certain compounds having certain required carbon atoms may have a melting point of less than 25 °C. Such compounds of low melting point are not intended to be included in this section. Nonlimiting examples of the high melting point compounds are found in International Cosmetic Ingredient Dictionary, Fifth Edition, 1993, and CTFA Cosmetic Ingredient Handbook, Second Edition, 1992.

The solid fatty compound is included in the composition at a level by weight of from about 0.1% to about 20%, preferably from about 1% to about 15%, more preferably from about 2% to about 10%.

The fatty alcohols useful herein are those having from about 14 to about

30 carbon atoms, preferably from about 16 to about 22 carbon atoms. These fatty alcohols are saturated and can be straight or branched chain alcohols. Nonlimiting examples of fatty alcohols include, cetyl alcohol, stearyl alcohol, behenyl alcohol, and mixtures thereof.

- 5           The fatty acids useful herein are those having from about 10 to about 30 carbon atoms, preferably from about 12 to about 22 carbon atoms, and more preferably from about 16 to about 22 carbon atoms. These fatty acids are saturated and can be straight or branched chain acids. Also included are diacids, triacids, and other multiple acids which meet the requirements herein.
- 10       Also included herein are salts of these fatty acids. Nonlimiting examples of fatty acids include lauric acid, palmitic acid, stearic acid, behenic acid, sebacic acid, and mixtures thereof.

          Solid fatty compounds of a single compound of high purity are preferred. Single compounds of pure fatty alcohols selected from the group of pure cetyl  
15       alcohol, stearyl alcohol, and behenyl alcohol are highly preferred. By "pure" herein, what is meant is that the compound has a purity of at least about 90%, preferably at least about 95%. These single compounds of high purity may provide good rinsability from the hair when the consumer rinses off the composition.

- 20           Commercially available solid fatty compounds useful herein include: cetyl alcohol, stearyl alcohol, and behenyl alcohol having tradenames KONOL series available from Shin-nihon Rika (Osaka, Japan), and NAA series available from NOF (Tokyo, Japan); pure behenyl alcohol having tradename 1-DOCOSANOL available from Wako (Osaka, Japan), various fatty acids having tradenames  
25       NEO-FAT available from Akzo (Chicago, Illinois, USA), HYSTRENE available from Witco Corp. (Dublin, Ohio, USA), and DERMA available from Vevy (Genova, Italy).

- While poly fatty alcohols may form the gel matrix, mono fatty alcohols are preferred. Either the cationic surfactant, and/or the solid fatty compound may be  
30       first mixed with, suspended in, and/or dissolved in water when forming a gel matrix.

## 2. Oil

An oil, having a melting point of less than about 25 °C, may also be useful herein. These oils may provide conditioning benefits such as softness and flexibility to the hair. Nonlimiting examples of the oils useful herein are found in  
5 International Cosmetic Ingredient Dictionary, Fifth Edition, 1993, and CTFA Cosmetic Ingredient Handbook, Second Edition, 1992.

Due to its HLB, the alkoxylate compound qualifies as an oil-miscible agent. It has now been found that these alkoxylate compounds may undesirably  
10 migrate to the aqueous phase, suffer from stability issues, and/or possess inadequate deposition efficiency when included by themselves in an aqueous carrier. Without intending to be limited by theory, it is believed that these stability problems arise from solubility differences between the typical production temperature and the typical storage temperature, chemical degradation of the oil-  
15 miscible agent, etc. In certain cases, it is believed that a phase change in-and-of-itself may affect stability and/or deposition efficiency. For example, the alkoxylate compounds described herein may be more water-soluble at lower temperatures (e.g., storage temperatures), than at higher temperatures (e.g., production temperatures). If such an alkoxylate compound enters the aqueous  
20 phase from the oil-phase, its deposition efficiency onto hair may be significantly reduced. In such a case, even though it is not degraded or otherwise chemically altered, the oil-miscible agent may not efficiently deposit on the hair, because it is too easily washed away during use. Such a low deposition efficiency is undesirable.

25 Thus, it has now been found that stability and deposition efficiency of certain oil-miscible agents may decrease as they migrate from one phase to the other over time (e.g., during storage, transport, etc.). Thus, such a phase change may result in a significant decrease in the overall performance of the composition. It is therefore desirable to minimize such undesirable phase  
30 changes. Accordingly, in a preferred embodiment, the suitable carrier comprises an oil having an HLB value of from about 0 to about 3, preferably from about 0 to

about 2, and more preferably from about 0 to about 1. Without intending to be limited by theory, it is believed that such oils tend to have an affinity for hair, and thus easily deposit thereupon. As noted, the alkoxyate compound is miscible in oil. Thus, when mixed with this alkoxyate compound prior to its addition to the  
5 suitable carrier, the oil may entrap the alkoxyate compound therein. Furthermore, the low HLB value of these oils provides a highly hydrophobic environment which reduces the likelihood that the alkoxyate compound will undergo a phase change during storage. This in turn enhances the alkoxyate compound's stability during storage, and prevents it from easily washing away  
10 during, for example, rinsing of the hair. Thus, such an oil is especially preferred in a rinse-off hair conditioning composition, or a hair shampoo composition. In addition to entrapping the alkoxyate compound therein, the oil may also act as a carrier which itself further enhances actual deposition. Additionally, the oil may itself provide desirable benefits, such as improved combability, dry-hair feel,  
15 shininess, softness, smoothness, and/or slipperiness.

Preferred examples of the oil useful herein include ester oils, liquid fatty alcohols and their derivatives, fatty acids and their derivatives, hydrocarbons, silicone compounds, and mixtures thereof which possess an HLB value of from about 0 to about 3, preferably from about 0 to about 2, and more preferably from  
20 about 0 to about 1. More preferred examples of the oil useful herein include ester oils, fatty acid esters, liquid fatty alcohols and fatty acids, hydrocarbons, and mixtures thereof which possess the above HLB value. Even more preferred examples of the oil useful herein include liquid fatty alcohols such as oleyl alcohol, isostearyl alcohol, isocetyl alcohol and mixtures thereof which fall  
25 within the above HLB range.

Unless otherwise specifically noted, the oil may be included at a level of from about 0.1% to about 20%, preferably from about 0.5% to about 10%, more preferably from about 1% to about 8% by weight of the hair care composition.

30 a. Ester Oil

The ester oil useful herein is of the formula:

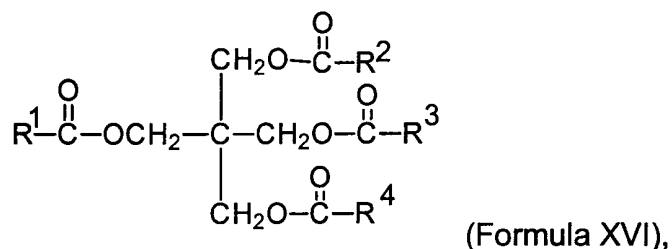
$R^2COOR^2$  (Formula XV),

wherein each  $R^2$  is independently a  $C_1$ - $C_{22}$  alkyl, and preferably at least one  $R^2$  is a  $C_8$ - $C_{22}$  alkyl. Each  $R^2$  may be either a straight, cyclic, or branched alkyl chain. If  $R^2$  is branched, it is preferred that  $R^2$  have from 2 to 4 branches. The HLB value of the ester oil is less than about 4, preferably from about 0 to about 3. The ester oil useful herein should be easy to formulate, and process. Accordingly, the ester oil typically has a melting point of less than about 40 °C, and is preferably water-insoluble, and in a liquid form at 25 °C.

Unless otherwise noted herein, the ester oils useful herein have a weight average molecular weight of greater than about 70 g/mol, preferably from about 100 g/mol to about 2,000 g/mol, and more preferably from about 160 g/mol to about 1,200 g/mol are especially useful herein. The preferred ester oil useful herein includes pentaerythritol ester oils, trimethylol ester oils, citrate ester oils, glyceryl ester oils, and mixtures thereof.

Without intending to be limited by theory, it is believed that ester oils efficiently deliver the alkoxylate compound to the hair, reduce flyaway hair volume, and/or provide other hair conditioning benefits. Furthermore, the ester oil herein provides moisturized feel, smooth feel, and manageability control to the hair when the hair is dried, yet does not leave the hair feeling greasy. Thus, with the addition of the ester oil, a hair care composition is obtained which may provide particularly suitable conditioning benefits both when the hair is wet and also after it has dried.

Pentaerythritol ester oils useful herein are those of the following formula having a weight average molecular weight of at least 800 g/mol:

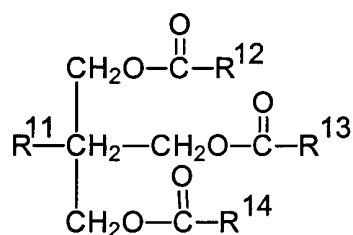


wherein  $R^1$ ,  $R^2$ ,  $R^3$ , and  $R^4$ , independently, are branched, straight, saturated, or unsaturated alkyl, aryl, and alkylaryl groups having from 1 to about 30 carbons.



Preferably,  $R^1$ ,  $R^2$ ,  $R^3$ , and  $R^4$ , independently, are branched, straight, saturated, or unsaturated alkyl groups having from about 8 to about 22 carbons. More preferably,  $R^1$ ,  $R^2$ ,  $R^3$  and  $R^4$  are defined so that the weight average molecular weight of the compound is from about 800 g/mol to about 1,200 g/mol.

- 5 Trimethylol ester oils useful herein are those of the following formula having a weight average molecular weight of at least 800 g/mol:

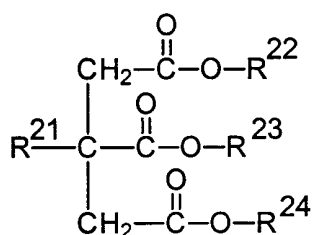


(Formula XVII),

- wherein  $R^{11}$  is an alkyl group having from 1 to about 30 carbons, and  $R^{12}$ ,  $R^{13}$ , and  $R^{14}$ , independently, are branched, straight, saturated, or unsaturated alkyl, aryl, and alkylaryl groups having from 1 to about 30 carbons. Preferably,  $R^{11}$  is ethyl and  $R^{12}$ ,  $R^{13}$ , and  $R^{14}$ , independently, are branched, straight, saturated, or unsaturated alkyl groups having from 8 to about 22 carbons. More preferably,  $R^{11}$ ,  $R^{12}$ ,  $R^{13}$  and  $R^{14}$  are defined so that the weight average molecular weight of the compound is from about 800 g/mol to about 1,200 g/mol.

- 15 Particularly preferable ester oils are pentaester oils and trimethylol ester oils, and more preferably pentaerythritol tetraisostearate, pentaerythritol tetraoleate, trimethylolpropane triisostearate, trimethylolpropane trioleate, and mixtures thereof. Such compounds are available from Kokyo Alcohol (Tokyo, Japan) with the tradenames KAK P.T.I., and KAK T.T.I., and Shin-nihon Rika  
20 (Tokyo, Japan) with the tradenames PTO, and ENUJERUBU TP3SO.

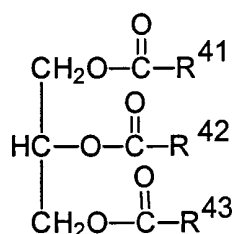
Citrate ester oils useful herein are those having a weight average molecular weight of at least about 500 g/mol having the following formula:



(Formula XVIII),

wherein  $\text{R}^{21}$  is OH or  $\text{CH}_3\text{COO}$ , and  $\text{R}^{22}$ ,  $\text{R}^{23}$ , and  $\text{R}^{24}$ , independently, are branched, straight, saturated, or unsaturated alkyl, aryl, and alkylaryl groups having from 1 to about 30 carbons. Preferably,  $\text{R}^{21}$  is OH, and  $\text{R}^{22}$ ,  $\text{R}^{23}$ , and  $\text{R}^{24}$ , independently, are branched, straight, saturated, or unsaturated alkyl, aryl, and alkylaryl groups having from 8 to about 22 carbons. More preferably,  $\text{R}^{21}$ ,  $\text{R}^{22}$ ,  $\text{R}^{23}$  and  $\text{R}^{24}$  are defined so that the weight average molecular weight of the compound is at least about 800 g/mol. Particularly useful citrate ester oils herein include triisocetyl citrate with tradename CITMOL 316 available from Bernel, triisostearyl citrate with tradename PELEMOL TISC available from Phoenix, and trioctyldodecyl citrate with tradename CITMOL 320 available from Bernel.

Glyceryl ester oils useful herein are those having a weight average molecular weight of at least about 400 g/mol and having the following formula:



(Formula XIX),

wherein  $\text{R}^{41}$ ,  $\text{R}^{42}$ , and  $\text{R}^{43}$ , independently, are branched, straight, saturated, or unsaturated alkyl, aryl, and alkylaryl groups having from 1 to about 30 carbons. Preferably,  $\text{R}^{41}$ ,  $\text{R}^{42}$ , and  $\text{R}^{43}$ , independently, are branched, straight, saturated, or unsaturated alkyl, aryl, and alkylaryl groups having from 8 to about 22 carbons. More preferably,  $\text{R}^{41}$ ,  $\text{R}^{42}$ , and  $\text{R}^{43}$  are defined so that the weight average molecular weight of the compound is at least about 500 g/mol.

Particularly useful glyceryl ester oils herein include caprylic/capric triglyceride with the tradename Miglyol812, from Degussa-Hüls AG (Frankfurt, Germany), triisostearin with tradename SUN ESPOL G-318 available from Taiyo

Kagaku, triolein with tradename CITHROL GTO available from Croda, Inc. (New Jersey, U.S.A.), trilinolein with tradename EFADERMA-F available from Vevy (Genova, Italy), or tradename EFA-GLYCERIDES from Brooks (South Plainfield, New Jersey, USA).

5

b. Liquid Fatty Alcohol and Fatty Acid

The liquid fatty alcohol and fatty acid useful herein have a melting point below 25 °C, and include those having from about 10 to about 30 carbon atoms, preferably from about 12 to about 22 carbon atoms, and more preferably from  
10 about 16 to about 22 carbon atoms. They can be straight, cyclic, or branched chain acids and can be saturated or unsaturated. Nonlimiting examples of these compounds include oleyl alcohol, palmitoleic alcohol, isostearyl alcohol, isocetyl alcohol and mixtures thereof. While poly fatty alcohols are useful herein, mono fatty alcohols are preferred. Suitable fatty acids include, for example, oleic acid,  
15 linoleic acid, isostearic acid, linolenic acid, ethyl linolenic acid, ethyl linolenic acid, arachidonic acid, and ricinolic acid.

The fatty acid derivatives and fatty alcohol derivatives are defined herein to include, for example, esters of fatty acids, alkoxylated fatty alcohols, alkyl ethers of fatty alcohols, alkyl ethers of alkoxylated fatty alcohols, and mixtures  
20 thereof. Nonlimiting examples of fatty acid derivatives and fatty alcohol derivatives, include, for example, methyl linoleate, ethyl linoleate, isopropyl linoleate, isodecyl oleate, isopropyl oleate, ethyl oleate, octyldodecyl oleate, oleyl oleate, decyl oleate, butyl oleate, methyl oleate, octyldodecyl stearate, octyldodecyl isostearate, octyldodecyl isopalmitate, octyl isopelargonate, octyl  
25 pelargonate, hexyl isostearate, isopropyl isostearate, isodecyl isononanoate, isopropyl isostearate, ethyl isostearate, methyl isostearate and oleth-2.

Commercially available liquid fatty alcohols and their derivatives useful herein include: oleyl alcohol with tradename UNJECOL 90BHR available from Shin-nihon Rika, various liquid esters with tradenames SCHERCEMOL series  
30 available from Scher, and hexyl isostearate with a tradename HIS and isopropyl isostearate having a tradename ZPIS available from Kokyu Alcohol.

c. Hydrocarbon

The hydrocarbons useful herein include straight chain, cyclic, and branched chain hydrocarbons which can be either saturated or unsaturated, so long as they have a melting point of not more than about 25 °C. These hydrocarbons have from about 12 to about 40 carbon atoms, preferably from about 12 to about 30 carbon atoms, and preferably from about 12 to about 22 carbon atoms. Also encompassed herein are polymeric hydrocarbons of alkenyl monomers, such as polymers of C<sub>2-6</sub> alkenyl monomers. These polymers can be straight or branched chain polymers. The straight chain polymers will typically be relatively short in length, having a total number of carbon atoms as described above. The branched chain polymers can have substantially higher chain lengths. The number average molecular weight of such materials can vary widely, but will typically be up to about 500 g/mol, preferably from about 200 g/mol to about 400 g/mol, and more preferably from about 300 g/mol to about 350 g/mol. Also useful herein are the various grades of mineral oils. Mineral oils are liquid mixtures of hydrocarbons that are obtained from petroleum. Specific examples of suitable hydrocarbon materials include paraffin oil, mineral oil, dodecane, isododecane, hexadecane, isohexadecane, eicosene, isoeicosene, tridecane, tetradecane, polybutene, polyisobutene, and mixtures thereof. Preferred for use herein are hydrocarbons selected from the group consisting of mineral oil, poly  $\alpha$ -olefin oils such as isododecane, isohexadecane, polybutene, polyisobutene, and mixtures thereof.

Poly  $\alpha$ -olefin oils useful herein are those derived from 1-alkene monomers having from about 6 to about 16 carbons, preferably from about 6 to about 12 carbons atoms. Nonlimiting examples of 1-alkene monomers useful for preparing the poly  $\alpha$ -olefin oils include 1-hexene, 1-octene, 1-decene, 1-dodecene, 1-tetradecene, 1-hexadecene, branched isomers such as 4-methyl-1-pentene, and mixtures thereof. Preferred 1-alkene monomers useful for preparing the poly  $\alpha$ -olefin oils are 1-octene, 1-decene, 1-dodecene, 1-tetradecene, 1-hexadecene, and mixtures thereof. Poly  $\alpha$ -olefin oils useful

herein further have a viscosity of from about 1 to about 35,000 cps, a weight average molecular weight of from about 200 g/mol to about 60,000 g/mol, and a polydispersity of no more than about 3.

Poly  $\alpha$ -olefin oils having a weight average molecular weight of at least  
5 about 800 g/mol are useful herein, to provide long lasting moisturized feel to the hair. However, poly  $\alpha$ -olefin oils having a weight average molecular weight of less than about 800 g/mol are also useful herein, to provide a smooth, light, clean feel to the hair. Particularly useful poly  $\alpha$ -olefin oils herein include polydecenes with tradename PURESYN 6 having a weight average molecular  
10 weight of about 500 and PURESYN 100 having a weight average molecular weight of over 3000 g/mol available from Mobil Chemical Co.

Commercially available hydrocarbons useful herein include isododecane, isohexadecane, and isoeicosene with tradenames PERMETHYL 99A, PERMETHYL 101A, and PERMETHYL 1082, available from Presperse (South  
15 Plainfield New Jersey, USA), a copolymer of isobutene and normal butene with tradenames INDOPOL H-100 available from Amoco Chemicals (Chicago Illinois, USA), mineral oil with tradename BENOL available from Witco Chemicals, isoparaffin with tradename ISOPAR from Exxon Chemical Co. (Houston Texas, USA), and polydecene with tradename PURESYN 6 from Mobil Chemical Co.

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#### d. Silicone Compound

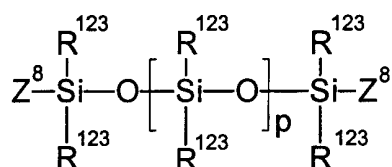
The hair care composition of the present invention preferably contains a silicone compound. The silicone compounds useful herein include volatile soluble or insoluble, or nonvolatile soluble or insoluble silicone conditioning  
25 agents. By soluble what is meant is that the silicone compound is miscible with the carrier of the composition so as to form part of the same phase. By insoluble what is meant is that the silicone forms a separate, discontinuous phase from the carrier, such as in the form of an emulsion or a suspension of droplets of the silicone. The silicone compounds herein may be made by any suitable method  
30 known in the art, including emulsion polymerization. The silicone compounds may further be incorporated in the present composition in the form of an

emulsion, wherein the emulsion is made by mechanical mixing, or in the stage of synthesis through emulsion polymerization, with or without the aid of a surfactant selected from anionic surfactants, nonionic surfactants, cationic surfactants, and mixtures thereof.

5 The silicone compounds for use herein will preferably have a viscosity of from about 1,000 to about 2,000,000 centistokes at 25 °C, more preferably from about 10,000 to about 1,800,000, and even more preferably from about 100,000 to about 1,500,000. The viscosity can be measured by means of a glass capillary viscometer as set forth in Dow Corning Corporate Test Method  
 10 CTM0004, July 20, 1970. Silicone compounds of high molecular weight may be made by emulsion polymerization. Suitable silicone fluids include polyalkyl siloxanes, polyaryl siloxanes, polyalkylaryl siloxanes, polyether siloxane copolymers, and mixtures thereof. Other nonvolatile silicone compounds having hair conditioning properties can also be used.

15 The silicone compound is preferably included in the composition at a level by weight from about 0.01% to about 20%, more preferably from about 0.05% to about 10%.

The silicone compounds herein also include polyalkyl or polyaryl siloxanes with the following Formula XX:



(Formula XX),

20 wherein  $\text{R}^{123}$  is alkyl or aryl, and  $x$  is an integer from about 7 to about 8,000.  $\text{Z}^8$  represents groups which block the ends of the silicone chains. The alkyl or aryl groups substituted on the siloxane chain ( $\text{R}^{123}$ ) or at the ends of the siloxane chains  $\text{Z}^8$  can have any structure as long as the resulting silicone remains fluid at  
 25 room temperature, is dispersible, is neither irritating, toxic nor otherwise harmful when applied to the hair, is compatible with the other components of the composition, is chemically stable under normal use and storage conditions, and is capable of being deposited on and conditions the hair. Suitable  $\text{Z}^8$  groups

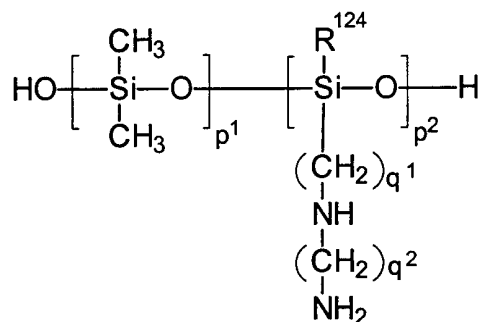
include hydroxy, methyl, methoxy, ethoxy, propoxy, and aryloxy. The two  $R^{123}$  groups on the silicon atom may represent the same group or different groups. Preferably, the two  $R^{123}$  groups represent the same group. Suitable  $R^{123}$  groups include methyl, ethyl, propyl, phenyl, methylphenyl and phenylmethyl. The preferred silicone compounds are polydimethylsiloxane, polydiethylsiloxane, and polymethylphenylsiloxane. Polydimethylsiloxane, which is also known as dimethicone, is especially preferred. The polyalkylsiloxanes that can be used include, for example, polydimethylsiloxanes. These silicone compounds are available, for example, from the General Electric Company in their Viscasil® and SF 96 series, and from Dow Corning in their Dow Corning 200 series.

Polyalkylaryl siloxane fluids can also be used and include, for example, polymethylphenylsiloxanes. These siloxanes are available, for example, from the General Electric Company as SF 1075 methyl phenyl fluid or from Dow Corning as 556 Cosmetic Grade Fluid.

Especially preferred, for enhancing the shine characteristics of hair, are highly arylated silicone compounds, such as highly phenylated polyethyl silicone having refractive index of about 1.46 or higher, especially about 1.52 or higher. When these high refractive index silicone compounds are used, they should be mixed with a spreading agent, such as a surfactant or a silicone resin, as described below to decrease the surface tension and enhance the film forming ability of the material.

The silicone compounds that can be used include, for example, a polypropylene oxide modified polydimethylsiloxane although ethylene oxide or mixtures of ethylene oxide and propylene oxide can also be used. The ethylene oxide and polypropylene oxide level should be sufficiently low so as not to interfere with the dispensability characteristics of the silicone. These material are also known as dimethicone copolyols.

Other silicone compounds include amino substituted materials. Suitable alkylamino substituted silicone compounds include those represented by the following Formula XXI:



(Formula XXI),

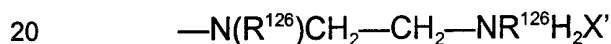
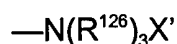
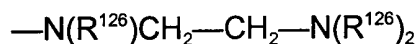
wherein  $\text{R}^{124}$  is H,  $\text{CH}_3$  or OH,  $p^1$ ,  $p^2$ ,  $q^1$  and  $q^2$  are integers which depend on the molecular weight, the weight average molecular weight being approximately between 5,000 and 10,000. This polymer is also known as "amodimethicone".

5        Suitable amino substituted silicone fluids include those represented by the Formula XXII:



(Formulca XXII),

10        in which G is chosen from the group consisting of hydrogen, phenyl, OH,  $\text{C}_1\text{--C}_8$  alkyl and preferably methyl; a denotes 0 or an integer from 1 to 3, and preferably equals 0; b denotes 0 or 1 and preferably equals 1; the sum  $p^3+p^4$  is a number from 1 to 2,000 and preferably from 50 to 150,  $p^3$  being able to denote a number from 0 to 1,999 and preferably from 49 to 149 and  $p^4$  being able to denote an integer from 1 to 2,000 and preferably from 1 to 10;  $\text{R}^{125}$  is a monovalent radical  
 15        of formula  $\text{C}_{q^3}\text{H}_{2q^3}\text{L}$  in which  $q^3$  is an integer from 2 to 8 and L is chosen from the groups

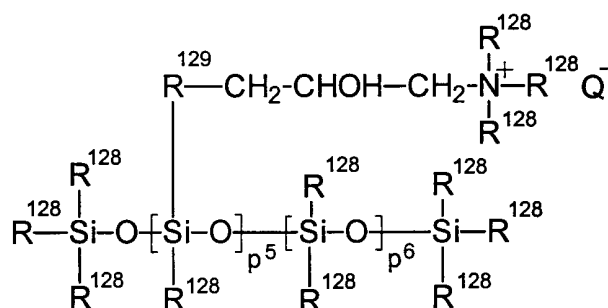


in which  $\text{R}^{126}$  is chosen from the group consisting of hydrogen, phenyl, benzyl, a saturated hydrocarbon radical, preferably an alkyl radical containing from 1 to 20 carbon atoms, and  $\text{X}'$  denotes a halide ion.



An especially preferred amino substituted silicone corresponding to formula (III) is the polymer known as "trimethylsilylamodimethicone" wherein  $R^{124}$  is  $CH_3$ .

Other amino substituted silicone polymers useful herein include cationic amino substituted silicones represented by the Formula XXIII:



(Formula XXIII),

where  $R^{128}$  denotes a monovalent hydrocarbon radical having from 1 to 18 carbon atoms, preferably an alkyl or alkenyl radical such as methyl;  $R^{129}$  denotes a hydrocarbon radical, preferably a  $C_1$ - $C_{18}$  alkylene radical or a  $C_1$ - $C_{18}$ , and more preferably  $C_1$ - $C_8$ , alkyleneoxy radical;  $Q^-$  is a halide ion, preferably chloride;  $p^5$  denotes an average statistical value from 2 to 20, preferably from 2 to 8;  $p^6$  denotes an average statistical value from 20 to 200, and preferably from 20 to 50. A preferred polymer of this class is available from Union Carbide under the name "UCAR SILICONE ALE 56."

References disclosing suitable nonvolatile dispersed silicone compounds include U.S. Patent No. 2,826,551 to Geen; U.S. Patent No. 3,964,500 to Drakoff, issued June 22, 1976; U.S. Patent No. 4,364,837 to Pader, issued December 21, 1982; and British Patent No. 849,433 to Woolston. "Silicon Compounds" distributed by Petrarch Systems, Inc., 1984, provides an extensive, though not exclusive, listing of suitable silicone compounds.

Another nonvolatile dispersed silicone that can be especially useful is a silicone gum. The term "silicone gum", as used herein, means a polyorganosiloxane material having a viscosity at 25 °C of greater than or equal to 1,000,000 centistokes. It is recognized that the silicone gums described herein can also have some overlap with the above-disclosed silicone

compounds. This overlap is not intended as a limitation on any of these materials. Silicone gums are described by Petrarch, and others including U.S. Patent No. 4,152,416, to Spitzer, *et al.*, issued May 1, 1979 and Noll, Walter, Chemistry and Technology of Silicones, New York: Academic Press 1968. Also  
5 describing silicone gums are General Electric Silicone Rubber Product Data Sheets SE 30, SE 33, SE 54 and SE 76. The "silicone gums" will typically have a weight average molecular weight in excess of about 200,000, generally between about 200,000 and about 1,000,000. Specific examples include polydimethylsiloxane, poly(dimethylsiloxane methylvinylsiloxane) copolymer,  
10 poly(dimethylsiloxane diphenylsiloxane methylvinylsiloxane) copolymer and mixtures thereof.

Also useful are silicone resins, which are highly crosslinked polymeric siloxane systems. The crosslinking is introduced through the incorporation of tri-functional and tetra-functional silanes with mono-functional or di-functional, or  
15 both, silanes during manufacture of the silicone resin. As is well understood in the art, the degree of crosslinking that is required in order to result in a silicone resin will vary according to the specific silane units incorporated into the silicone resin. In general, silicone materials which have a sufficient level of trifunctional and tetrafunctional siloxane monomer units, and hence, a sufficient level of  
20 crosslinking, such that they dry down to a rigid, or hard, film are considered to be silicone resins. The ratio of oxygen atoms to silicon atoms is indicative of the level of crosslinking in a particular silicone material. Silicone materials which have at least about 1.1 oxygen atoms per silicon atom will generally be silicone resins herein. Preferably, the ratio of oxygen:silicon atoms is at least about  
25 1.2:1.0. Silanes used in the manufacture of silicone resins include monomethyl-, dimethyl-, trimethyl-, monophenyl-, diphenyl-, methylphenyl-, monovinyl-, and methylvinylchlorosilanes, and tetrachlorosilane, with the methyl substituted silanes being most commonly utilized. Preferred resins are offered by General Electric as GE SS4230 and SS4267. Commercially available silicone resins will  
30 generally be supplied in a dissolved form in a low viscosity volatile or nonvolatile silicone fluid. The silicone resins for use herein should be supplied and

incorporated into the present compositions in such dissolved form, as will be readily apparent to those skilled in the art. Without being bound by theory, it is believed that the silicone resins can enhance deposition of other silicone compounds on the hair and can enhance the glossiness of hair with high refractive index volumes.

Other useful silicone resins are silicone resin powders such as the material given the CTFA designation polymethylsilsequioxane, which is commercially available as Tospearl™ from Toshiba Silicones.

The method of manufacturing these silicone compounds, can be found in Encyclopedia of Polymer Science and Engineering, Volume 15, Second Edition, pp. 204-308, John Wiley & Sons, Inc., 1989.

Silicone materials and silicone resins in particular may conveniently be identified according to a shorthand nomenclature system well known to those skilled in the art as the "MDTQ" nomenclature. Under this system, the silicone is described according to the presence of various siloxane monomer units which make up the silicone. Briefly, the symbol M denotes the mono-functional unit  $(\text{CH}_3)_3\text{SiO}_{0.5}$ ; D denotes the difunctional unit  $(\text{CH}_3)_2\text{SiO}$ ; T denotes the trifunctional unit  $(\text{CH}_3)\text{SiO}_{1.5}$ ; and Q denotes the quadri- or tetra-functional unit  $\text{SiO}_2$ . Primes of the unit symbols, e.g., M', D', T', and Q' denote substituents other than methyl, and must be specifically defined for each occurrence. Typical alternate substituents include groups such as vinyl, phenyl, amino, hydroxyl, etc. The molar ratios of the various units, either in terms of subscripts to the symbols indicating the total number of each type of unit in the silicone, or an average thereof, or as specifically indicated ratios in combination with the weight average molecular weight, complete the description of the silicone material under the MDTQ system. Higher relative molar amounts of T, Q, T' and/or Q' to D, D', M and/or or M' in a silicone resin is indicative of higher levels of crosslinking. As discussed before, however, the overall level of crosslinking can also be indicated by the oxygen to silicon ratio.

The silicone resins for use herein which are preferred are MQ, MT, MTQ, MQ and MDTQ resins. Thus, the preferred silicone substituent is methyl.

Especially preferred are MQ resins wherein the M:Q ratio is from about 0.5:1.0 to about 1.5:1.0 and the weight average molecular weight of the resin is from about 1000 to about 10,000.

Commercially available silicone compounds which are useful herein  
5 include Dimethicone with tradename D-130, cetyl Dimethicone with tradename DC2502, stearyl Dimethicone with tradename DC2503, emulsified polydimethyl siloxanes with tradenames DC1664 and DC1784, and alkyl grafted copolymer silicone emulsion with tradename DC2-2845; all available from Dow Corning Corporation, and emulsion polymerized Dimethiconol available from Toshiba  
10 Silicone as described in GB application 2,303,857.

#### OTHER ADDITIONAL COMPONENTS

Certain other additional components are preferred in the present invention. These include, compounds which may provide, for example, an  
15 additional hair care, and/or hair conditioning benefit when included herein. Preferred other additional components include a hydrophobically modified cellulose ether, a cationic conditioning compound, an anti-microbial agent, an herbal extract, polyethylene glycol derivatives of glycerides, and mixtures thereof. Unless otherwise noted, such other additional components generally are typically  
20 used individually at levels from about 0.001% to about 10.0%, preferably from about 0.01% to about 5.0% by weight of the hair care composition.

##### 1. Hydrophobically Modified Cellulose Ether

It is preferred that the hair care composition contain, by weight of the hair  
25 care composition, from about 0.01% to about 2%, preferably from about 0.01% to about 0.5%, and more preferably from about 0.1% to about 0.5%, of a hydrophobically modified cellulose ether.

The hydrophobically modified cellulose ethers may provide an increase in bulk hair volume. When combined with the polypropylene glycol and ester oil of  
30 the present invention, the hydrophobically modified cellulose ethers may provide a balance between decreased flyaway hair, and increased bulk hair. The

controlled level of hydrophobically modified cellulose ether also provides acceptable rheology profiles in the conditioning composition of this invention, so this composition provides satisfactory spreadability on the hair. The hydrophilic cellulose backbone has a weight average molecular weight of about less than  
5 800,000 g/mol, preferably from about 20,000 g/mol to about 700,000 g/mol, and more preferably from about 50,000 g/mol to about 700,000 g/mol. Hydroxyethyl cellulose of this molecular weight is known to be one of the most hydrophilic of the materials contemplated. Thus, hydroxyethyl cellulose can be modified to a greater extent than other hydrophilic cellulose backbones.

10 The hydrophilic cellulose backbone is further substituted with a hydrophobic substitution group via an ether linkage to render the hydrophobically modified cellulose ether to have less than 1% water solubility, preferably less than 0.2% water solubility. The hydrophobic substitution group is selected from a straight or branched chain alkyl group of from about 10 to about 22 carbons;  
15 wherein the ratio of the hydrophilic groups in the hydrophilic cellulose backbone to the hydrophobic substitution group being from about 2:1 to about 1000:1, preferably from about 10:1 to about 100:1.

Commercially available hydrophobically modified cellulose ethers useful herein include: cetyl hydroxyethylcellulose having tradenames NATROSOL  
20 PLUS 330CS and POLYSURF 67, both available from Aqualon Company, Delaware, USA, having a cetyl group substitution of about 0.4% to about 0.65% by weight of the entire polymer.

## 2. Cationic Conditioning Compound

25 A cationic hair conditioning compound is preferred herein, and includes the cationic surfactants described above, cationic polymers, cationic polysaccharide polymers, the cationic amino substituted silicones described above, and mixtures thereof. If present, the cationic hair conditioning compound is typically at a level of preferably from about 0.5% to about 10%, more  
30 preferably from about 2% to about 5%, and even more preferably from about 1% to about 3% by weight of the composition.

The hair care compositions of the present invention may comprise one or more cationic polymers. As used herein, the term "polymer" includes materials whether made by polymerization of one type of monomer or made by two (i.e., copolymers) or more types of monomers. Preferably, the cationic polymer is a water-soluble cationic polymer. As used herein, the term "water-soluble" cationic polymer, indicates a polymer which is sufficiently soluble in water to form a substantially clear solution to the naked eye at a concentration of 0.1% in water (distilled or equivalent) at 25 °C. The preferred cationic polymer will be sufficiently soluble to form a substantially clear solution at 0.5% concentration, more preferably at 1.0% concentration.

The cationic polymers herein will generally have a weight average molecular weight which is at least about 5,000, preferably from about 10,000 to about 10 million, more preferably, from about 100,000 to about 2 million. The cationic polymer will generally have cationic nitrogen-containing moieties such as quaternary ammonium or cationic amino moieties, and mixtures thereof.

The cationic nitrogen-containing moiety will be present generally as a substituent, on a fraction of the total monomer units of the cationic hair conditioning polymers. Thus, the cationic polymer may comprise copolymers, terpolymers, etc. of quaternary ammonium or cationic amine-substituted monomer units and other non-cationic units referred to herein as spacer monomer units. Such polymers are known in the art, and a variety may be found in the CTFA Cosmetic Ingredient Dictionary, 3rd edition, edited by Estrin, Crosley, and Haynes, (The Cosmetic, Toiletry, and Fragrance Association, Inc., Washington, D.C., 1982).

The cationic charge density of the cationic polymer is preferably at least about 0.1 meq/gram, more preferably at least about 0.5 meq/gram, even more preferably at least about 1.1 meq/gram, and still more preferably at least about 1.2 meq/gram, and most preferably at least about 1.5 meq/g. Generally, the cationic polymers will have a cationic charge density of less than about 5 meq/g, preferably less than 3.5 meq/g, more preferably less than about 2.5 meq/g and most preferably less than about 2.2 meq/g. The 'cationic charge density' of a

polymer refers to the ratio of the number of positive charges on a monomeric unit of which the polymer is comprises to the molecular weight of said monomeric unit.

Cationic charge density of the cationic polymer may be determined according to the Kjeldahl Method. Those skilled in the art will recognize that the charge density of amino-containing polymers may vary depending upon pH and the isoelectric point of the amino groups. The charge density should be within the above limits at the pH of intended use.

Any anionic counterion may be utilized for the cationic polymers so long as the water solubility criteria is met. Suitable counterions include, for example, halides (e.g., Cl, Br, I, or F, preferably Cl, Br, or I), sulfate, and methylsulfate.

Suitable cationic polymers include, for example, copolymers of vinyl monomers having cationic amine or quaternary ammonium functionalities with water-soluble spacer monomers such as acrylamide, methacrylamide, alkyl and dialkyl acrylamides, alkyl and dialkyl methacrylamides, alkyl acrylate, alkyl methacrylate, vinyl caprolactone, and vinyl pyrrolidone. The cationic amines may be primary, secondary, or tertiary amines, depending upon the particular species and the pH of the composition. In general, secondary and tertiary amines, especially tertiary amines, are preferred. The alkyl and dialkyl substituted monomers preferably have C<sub>1</sub> - C<sub>7</sub> alkyl groups, more preferably C<sub>1</sub> - C<sub>3</sub> alkyl groups. Other suitable spacer monomers include vinyl esters, vinyl alcohol (made by hydrolysis of polyvinyl acetate), maleic anhydride, propylene glycol, and ethylene glycol.

Amine-substituted vinyl monomers may be polymerized in the amine form, and then optionally may be converted to ammonium by a quaternization reaction. Amines may also be similarly quaternized subsequent to formation of the polymer. For example, tertiary amine functionalities may be quaternized by reaction with a salt of the formula R'X wherein R' is a short chain alkyl, preferably a C<sub>1</sub> - C<sub>7</sub> alkyl, more preferably a C<sub>1</sub> - C<sub>3</sub> alkyl, and X<sup>-</sup> is an anion which forms a water-soluble salt with the quaternized ammonium.

Suitable cationic amino and quaternary ammonium monomers include, for example, vinyl compounds substituted with dialkylaminoalkyl acrylate, dialkylaminoalkyl methacrylate, monoalkylaminoalkyl acrylate, monoalkylaminoalkyl methacrylate, trialkyl methacryloxyalkyl ammonium salt, trialkyl acryloxyalkyl ammonium salt, diallyl quaternary ammonium salts, and vinyl quaternary ammonium monomers having cyclic cationic nitrogen-containing rings such as pyridinium, imidazolium, and quaternized pyrrolidone, e.g., alkyl vinyl imidazolium, alkyl vinyl pyridinium, alkyl vinyl pyrrolidone salts. The alkyl portions of these monomers are preferably lower alkyls such as the C<sub>1</sub> - C<sub>3</sub> alkyls, more preferably C<sub>1</sub> and C<sub>2</sub> alkyls. Suitable amine-substituted vinyl monomers for use herein include dialkylaminoalkyl acrylate, dialkylaminoalkyl methacrylate, dialkylaminoalkyl acrylamide, and dialkylaminoalkyl methacrylamide, wherein the alkyl groups are preferably C<sub>1</sub> - C<sub>7</sub> hydrocarbyls, more preferably C<sub>1</sub> - C<sub>3</sub>, alkyls.

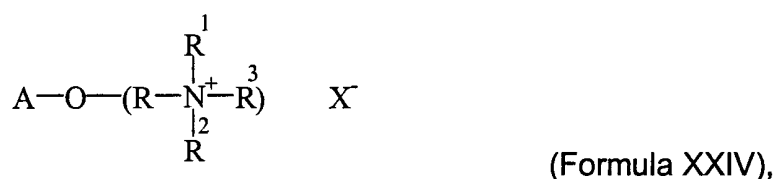
The cationic polymers useful herein may comprise mixtures of monomer units derived from amine- and/or quaternary ammonium-substituted monomer and/or compatible spacer monomers.

Suitable cationic hair conditioning polymers include, for example: copolymers of 1-vinyl-2-pyrrolidone and 1-vinyl-3-methylimidazolium salt (e.g., chloride salt) (CTFA name: Polyquaternium-16), such as those commercially available from BASF Wyandotte Corp. (Parsippany, New Jersey, USA) under the LUVIQUAT tradename (e.g., LUVIQUAT FC 370); copolymers of 1-vinyl-2-pyrrolidone and dimethylaminoethyl methacrylate (CTFA name: Polyquaternium-11) such as those commercially available from Gaf Corporation (Wayne, New Jersey, USA) under the GAFQUAT tradename (e.g., GAFQUAT 755N); cationic diallyl quaternary ammonium-containing polymers, including, for example, dimethyldiallylammonium chloride homopolymer and copolymers of acrylamide and dimethyldiallylammonium chloride (CTFA names: Polyquaternium 6 and Polyquaternium 7, respectively); and mineral acid salts of amino-alkyl esters of homo- and co-polymers of unsaturated carboxylic acids having from 3 to 5



carbon atoms, as described in U.S. Patent 4,009,256 issued to Nowack, et. al., on February 22, 1977.

Other useful cationic polymers include cationic polysaccharide polymers, such as cationic cellulose derivatives and cationic starch derivatives, such as  
 5 cationic polymers and copolymers of cellulose derivatives. Cationic polysaccharide polymer materials suitable for use herein include those of Formula (XXIV):



wherein: A is an anhydroglucose residual group, such as a starch or cellulose  
 10 anhydroglucose residual, R is an alkylene oxyalkylene, polyoxyalkylene, or hydroxyalkylene group, or combination thereof, R<sup>1</sup>, R<sup>2</sup>, and R<sup>3</sup> independently are alkyl, aryl, alkylaryl, arylalkyl, alkoxyalkyl, or alkoxyaryl groups, each group containing up to about 18 carbon atoms, and the total number of carbon atoms for each cationic moiety (i.e., the sum of carbon atoms in R<sup>1</sup>, R<sup>2</sup> and R<sup>3</sup>)  
 15 preferably being about 20 or less, and X<sup>-</sup> is an anionic counterion, as previously described.

Cationic polysaccharide polymers useful in the present invention also include those polymers based on 5, 6 or 7 carbon sugars and derivatives which have been made water-soluble by, for example, derivatizing them with ethylene  
 20 oxide. These polymers may be bonded via any of several arrangements, such as 1,4- $\alpha$ , 1,4- $\beta$ , 1,3- $\alpha$ , 1,3- $\beta$  and 1,6 linkages. The monomers may be in straight or branched chain geometric arrangements. Suitable examples include polymers based on arabinose monomers, polymers derived from xylose monomers, polymers derived from fructose monomers, polymers derived from fructose  
 25 monomers, polymers based on acid-containing sugar monomers such as galacturonic acid and glucuronic acid, polymers based on amine sugar monomers such as galactosamine and glucosamine, particularly actylglucosamine, polymers based on 5 or 6 membered ring polyalcohol

monomers, polymers based on galactose monomers, polymers based on mannose monomers and polymers based on galcatomannan monomers. The cationic polysaccharide polymer is preferably present at a level of from about 0.001% to about 20% of the hair care composition.

5           Cationic cellulose is available from Amerchol Corp. (Edison, New Jersey, USA) in their Polymer JR® and LR® series of polymers, as salts of hydroxyethyl cellulose reacted with trimethyl ammonium substituted epoxide (CTFA name: Polyquaternium 10). Another type of cationic cellulose includes the polymeric quaternary ammonium salts of hydroxyethyl cellulose reacted with lauryl dimethyl  
10   ammonium-substituted epoxide (CTFA name: Polyquaternium 24). These materials are available from Amerchol Corp. (Edison, New Jersey, USA) under the tradename Polymer LM-200®. Another type of cationic cellulose includes the polymeric quaternary ammonium salts of hydroxyethyl cellulose reacted with diallyl dimethyl ammonium chloride (CTFA name: Polyquaternium 4), available  
15   from National Starch (Salisbury, North Carolina, USA).

Other cationic polymers that may be used include cationic guar gum derivatives, such as guar hydroxypropyltrimonium chloride (commercially available from Celanese Corp. in their Jaguar R series). Other materials include quaternary nitrogen-containing cellulose ethers (e.g., as described in U.S. Patent  
20   3,962,418e), and copolymers of etherified cellulose and starch (e.g., as described in U.S. Patent 3,958,581).

### 3. Anti-Microbial Agent

Anti-microbial agents useful as encompassed material include those  
25   useful as cosmetic biocides and antidandruff agents including: water-soluble components such as piroctone olamine, water insoluble components such as 3,4,4'- trichlorocarbanilide (trichlosan), triclocarban and zinc pyrithione.

### 4. Herbal Extract

30           The compositions of the present invention may contain herbal extracts, including both water-soluble and water-insoluble herbal extracts. Useful herbal

extracts herein include: Polygonatum multiflori extract, Houttuynia cordate extract, Phellodendron Bark extract, melilot extract, white dead nettle extract, licorice root extract, herbaceous peony extract, soapwort extract, dishcloth gourd extract, cinchona extract, creeping saxifrage extract, Sophora angustifolia extract, candock extract, common fennel extract, primrose extract, rose extract, 5 Rehmannia glutinosa extract, lemon extract, shikon extract, aloe extract, iris bulb extract, eucalyptus extract, field horsetail extract, sage extract, thyme extract, tea extract, laver extract, cucumber extract, clove extract, raspberry extract, melissa extract, ginseng extract, carrot extract, horse chestnut extract, peach extract, 10 peach leaf extract, mulberry extract, cornflower extract, hamamelis extract, placenta extract, thymus extract, silk extract, algae extract, althea extract, angelica dahurica extract, apple extract, apricot kernel extract, arnica extract, Artemisia capillaris extract, astragal extract, balm mint extract, perilla extract, birch bark extract, bitter orange peel extract, Theasinensis extract, burdock root extract, burnet extract, butcherbroom extract, Stephania cepharantha extract, 15 matricaria extract, chrysanthemum flower extract, citrus unshiu peel extract, cnidium extract, coix seed extract, coltsfoot extract, comfrey leaf extract, crataegus extract, evening primrose oil, gambir extract, ganoderma extract, gardenia extract, gentian extract, geranium extract, ginkgo extract, grape leaf extract, 20 crataegus extract, henna extract, honeysuckle extract, honeysuckle flower extract, hoelen extract, hops extract, horsetail extract, hydrangea extract, hypericum extract, isodonis extract, ivy extract, Japanese angelica extract, Japanese coptis extract, juniper extract, jujube extract, lady's mantle extract, lavender extract, lettuce extract, licorice extract, linden extract, lithospermum extract, 25 loquat extract, luffa extract, malloti extract, mallow extract, calendula extract, moutan bark extract, mistletoe extract, mukurossi extract, mugwort extract, mulberry root extract, nettle extract, nutmeg extract, orange extract, parsley extract, hydrolyzed conchiorin protein, peony root extract, peppermint extract, philodendron extract, pine cone extract, platycodon extract, polygonatum extract, 30 rehmannia extract, rice bran extract, rhubarb extract, rose fruit extract, rosemary extract, royal jelly extract, safflower extract, saffron crocus extract,

sambucus extract, saponaria extract, Sasa albo marginata extract, Saxifraga stolonifera extract, scutellaria root extract, Cortinellus shiitake extract, lithospermum extract, sophora extract, laurel extract, calamus root extract, swertia extract, thyme extract, linden extract, tomato extract, turmeric extract, 5 uncaria extract, watercress extract, logwood extract, grape extract, white lily extract, rose hips extract, wild thyme extract, witch hazel extract, yarrow extract, yeast extract, yucca extract, zanthoxylum extract, and mixtures thereof.

Commercially available herbal extracts useful herein include Polygonatum multiflori extracts which are water-soluble, and available from Institute of 10 Occupational Medicine, CAPM, China National Light Industry, and Maruzen, and other herbal extracts listed above available from Maruzen.

#### 5. Polyethylene Glycol Derivatives of Glycerides

Suitable polyethylene glycol derivatives of glycerides include any 15 polyethylene glycol derivative of glycerides which are water-soluble and which are suitable for use in a hair care composition. Suitable polyethylene glycol derivatives of glycerides for use herein include derivatives of mono-, di- and tri-glycerides and mixtures thereof.

One class of polyethylene glycol derivatives of glycerides useful herein 20 includes those wherein the degree of ethoxylation is from about 4 to about 200, preferably from about 5 to about 150, more preferably from about 20 to about 120, and wherein the alkyl group comprises an aliphatic radical having from about 5 to about 25 carbon atoms, preferably from about 7 to about 20 carbon atoms.

25 Suitable polyethylene glycol derivatives of glycerides can be polyethylene glycol derivatives of hydrogenated castor oil. For example, PEG-20 hydrogenated castor oil, PEG-30 hydrogenated castor oil, PEG-40 hydrogenated castor oil, PEG-45 hydrogenated castor oil, PEG-50 hydrogenated castor oil, PEG-54 hydrogenated castor oil, PEG-55 hydrogenated castor oil, PEG-60 30 hydrogenated castor oil, PEG-80 hydrogenated castor oil, and PEG-100

hydrogenated castor oil. Preferred for use in the compositions herein is PEG-60 hydrogenated castor oil.

Other suitable polyethylene glycol derivatives of glycerides can be polyethylene glycol derivatives of stearic acid. For example, PEG-30 stearate, PEG-40 stearate, PEG-50 stearate, PEG-75 stearate, PEG-90 stearate, PEG-100 stearate, PEG-120 stearate, and PEG-150 stearate. Preferred for use in the compositions herein is PEG-100 stearate.

The hair care compositions herein may further contain other additional components, which may be selected by the artisan according to the desired characteristics of the final product and which are suitable for rendering the compositions more cosmetically or aesthetically acceptable or to provide them with additional usage benefits.

Additional examples of preferred other additional components which may be formulated into the present compositions include: other conditioning agents such as hydrolysed collagen with tradename Peptin 2000 available from Hormel, panthenol available from Roche, panthenyl ethyl ether available from Roche, hydrolysed keratin, proteins, plant extracts, and nutrients; vitamins and/or amino acids, such as vitamin E with tradename Emix-d available from Eisai; surfactants such as a cationic surfactant, a nonionic surfactant, an anionic surfactant, an amphoteric surfactant, and mixtures thereof; hair-fixative polymers such as amphoteric fixative polymers, cationic fixative polymers, anionic fixative polymers, nonionic fixative polymers, and silicone grafted copolymers; preservatives such as benzyl alcohol, methyl paraben, propyl paraben and imidazolidinyl urea; pH adjusting agents, such as citric acid, sodium citrate, succinic acid, phosphoric acid, sodium hydroxide, sodium carbonate; salts, in general, such as potassium acetate and sodium chloride; coloring agents, such as any of the FD&C or D&C dyes; hair oxidizing (bleaching) agents, such as hydrogen peroxide, perborate and persulfate salts; hair reducing agents such as the thioglycolates; perfumes; sequestering agents, such as disodium ethylenediamine tetra-acetate; ultraviolet and infrared screening and absorbing

agents, such as optical brighteners and octyl salicylate; and antidandruff agents, such as zinc pyridinethione.

#### MANUFACTURING PROCESS

5           In the present process, the alkoxyate compound is combined with the suitable carrier, along with any other additional components, and preferably homogenized, to form the hair care composition of the present invention. Generally, the equipment and processes useful herein are well-known in the art. Preferred manufacturing processes are detailed, below.

10           To form a highly preferred lamellar gel matrix, water is typically heated to at least about 70 °C, preferably between about 80 °C and about 90 °C. The cationic surfactant and the solid fatty compound are combined with the water to form a mixture. The temperature of the mixture is preferably maintained at a temperature higher than both the melting temperature of the cationic surfactant  
15           and the melting temperature of the solid fatty compound, and the entire mixture is homogenized. After mixing until no solids are observed, the mixture is gradually cooled (e.g., at a rate of about 2 °C/minute) to a temperature below 60 °C, preferably less than about 55 °C. During this gradual cooling process, a significant viscosity increase is observed at between about 55 °C and about 75  
20           °C. This indicates the formation of a lamellar gel matrix. The alkoxyate compound and any other remaining components are then combined with the gel matrix, and cooled to room temperature. This results in a hair care composition containing the alkoxyate compound which possesses significantly improved stability and excellent performance.

25           In a preferred process, the alkoxyate compound is first premixed with an oil at a weight ratio of oil to alkoxyate compound of from about 5:1 to about 1:1, more preferably from about 4:1 to about 1.5:1, and even more preferably from about 3:1 to about 2:1, to form a premix having an HLB value of less than about 4, preferably less than about 3, and more preferably between about 1 and 3.  
30           Typically, the oil and the alkoxyate compound will be stirred from about 1 to about 15 minutes, at a temperature of from about 20 °C to about 50 °C,

preferably from about 20 °C to about 25 °C, until the oil and the alkoxylate compound are homogenized and form the premix. Without intending to be limited by theory, it is believed that this improved process entraps the alkoxylate compound within the oil itself. Accordingly, when the premix is mixed with the  
5 suitable carrier, preferably an aqueous carrier, the trapped alkoxylate compound is much less likely to migrate into the aqueous phase, and is also protected from water-induced (or assisted) degradation. The premix is preferably mixed with the suitable carrier at a temperature of about 25 °C (i.e., room temperature). This results in the improved stability of compositions formed by this process.  
10 Furthermore, as certain oils useful herein possess a strong affinity for hair, they may also serve to increase the deposition efficiency of the alkoxylate compound onto hair. The premix may also contain other additional components, such as perfumes, and preservatives. In a highly preferred embodiment, the premix is homogenized with a gel matrix to form the hair care composition.

15

#### METHOD OF USE

The hair care composition of the present invention is suitable for use as, for example, hair cosmetic compositions, hair styling compositions, hair conditioning compositions, preferably as a leave-on and/or rinse-off hair  
20 conditioning composition, and more preferably as a rinse-off hair conditioning composition. These hair care compositions are used in conventional ways to provide the conditioning, styling, and/or other benefits of the present invention. Such method of use depends upon the type of composition employed but generally involves providing hair, or a hair sample, having a bulk hair area,  
25 applying of an effective amount of the product to the hair having a bulk hair area, and then drying the hair. Before drying, the hair care composition may be either rinsed from the hair (as in the case of hair rinses), or allowed to remain on the hair (as in the case of gels, lotions, and creams). "Effective amount" means an amount sufficient enough to provide the desired bulk hair reduction benefit. In  
30 general, from about 1 g to about 50 g is applied to the hair, and/or the scalp.

During the applying step, the hair care composition may be distributed

throughout the hair, typically by rubbing or massaging the hair and scalp, or the composition may be selectively applied to certain parts of the hair. For a leave-on form, the hair care composition is preferably applied to wet or damp hair prior to drying of the hair. After such hair care compositions are applied to the hair, the hair is dried and styled in accordance with the preference of the user. In the alternative, such as for a hair styling composition, it may be applied to already dry hair, and the hair is then combed or styled, and dried in accordance with the preference of the user.

#### 10 IMAGE ANALYSIS PROTOCOL

The Image Analysis Protocol is a system and procedure which is designed to digitally measure and analyze the components of bulk hair area and flyaway hair area, which in turn form the total hair area. This protocol provides a quantifiable, repeatable method for accurately distinguishing, measuring, and comparing total hair area, flyaway hair area, and bulk hair area before and after treatment with a hair care composition. This total hair area, flyaway hair area, and bulk hair area directly correlate with total hair volume, flyaway hair volume, and bulk hair volume, respectively. The hair care compositions of the present invention provide a significant, noticeable reduction in the bulk hair area, preferably by at least about 10%, more preferably by at least about 15%, and even more preferably by at least about 25%, as measured by the method described, below. Preferably, the hair care compositions of the present invention also provide a significant, noticeable reduction in the flyaway hair area by at least about 25%, preferably at least about 30%, and more preferably by at least about 40%, as measured by the method described, below.

It has been found that a reduction in bulk hair area and/or flyaway hair area correlates with one or more noticeable consumer-desirable benefits, such as enhanced manageability, improved combability, improved flyaway control, and/or frizz control. For example, it is believed that reduced bulk hair area correlates with moisturized hair which is softer, more plastic, smooth, and flexible than hair which is dried out. When hair is moisturized, the bulk hair area is



reduced, because the hair is better aligned with other hairs and has less space in-between the individual hairs. Moisturized hair is also easier to comb and manage. It is also believed that, reduced flyaway hair area correlates to moisturized hair which is less likely to tangle and to possess a high static charge.

5 Referring to the drawing, Fig. 1 shows a top view of a preferred embodiment of the Image Analysis System useful herein. The Image Analysis System, 10, consists of a white screen, 12, lighting equipment, 14, a sample holder, 16, a high-resolution digital camera, 18, and a personal computer, 20. The sample holder, 16, is placed between the white screen, 12, and the high-  
10 resolution digital camera, 18. The sample holder, 16, is typically a clip or clamp which stably suspends a hair sample, 22, about 40 cm in front of the white screen, 12. The sample holder, 16, is typically about 80 cm from the high-resolution digital camera, 18, and positioned above the high-resolution camera's field of view, so that it is not visible in the captured images.

15 The white screen, 12, is a matte-finish (e.g., non-glare) white-colored screen which is illuminated to provide a constant and repeatable background against which the hair sample, 22, is measured. As the difference between bulk hair area and flyaway hair area is judged according to the brightness of the image (see below), it is important that the hair sample be photographed in front  
20 of a background which has a constant brightness. As seen in Fig. 1, the preferred lighting equipment, 14, consists of twin photography lights located on each side of the sample, and pointing towards the white screen. Each of these lights is preferably a twin florescent tube light contained within a lighting fixture, and is typically from about 20 cm to about 60 cm to the side of the sample holder,  
25 16. This places them far enough away from the hair sample, 22, so that they are not visible by the high-resolution digital camera, 18. This assures that the captured image will only include the image of the hair sample, 22, and will not include, for example, the back-side of the lighting equipment, 14. Therefore, the lighting equipment, 14, should not interfere with or block the picture to be taken.  
30 Also, in such a configuration, the hair sample, 22, is not directly illuminated by the lighting equipment, 14. Instead, light is first reflected from the white screen,

12, and then passes through the hair sample, 22, in order to reach the high-resolution digital camera, 18. The high-resolution digital camera, 18, is focused on the hair sample, 22, and not the white screen, 12. For ease of use, the high-resolution digital camera, 18, is connected to a personal computer, 20, and automatically transfers the captured image to the computer's imaging software. Such an arrangement provides a precise picture of the profile of the hair sample, 22, and avoids any glare and/or shadows which could interfere with measurement and analysis of the hair sample, 22.

Preferably, the Image Analysis System should be located away from air currents or other forces which would disturb the hair sample, and is in a controlled temperature and humidity environment, so as to ensure repeatable results. The high-resolution digital camera (e.g., Model HC-2500 3-CCD from Fujifilm Co. of Tokyo, Japan) has a resolution of at least 1280 horizontal pixels, and 1000 vertical pixels. The high-resolution digital camera is calibrated to a linear gain, so that the incremental difference between all brightness values (an 8-bit, 0-255 brightness scale) is equal. Such a calibration may be achieved via, for example, utilizing a standard gray-scale calibration cell and/or the high-resolution digital camera's internal look-up-table (LUT). For calibration purposes, the white screen (when lit with the lighting equipment) should have a brightness value of greater than about 245, preferably from about 250 to about 255.

The typical hair sample consists of 15 cm (5 g) straight black Asian hair switches (available from Kawamura Co. of Osaka, Japan) or straight brown Caucasian hair switches (available from International Hair Importers & products Inc. of Bellerose, New York, USA). Straight black Asian hair switches are preferred, because their contrast against the white screen is more easily observable. The measurements using the Image Analysis Protocol are significantly easier and more reproducible when black hair switches are used. However, the hair area reduction benefits, and the corresponding hair volume reduction benefits, of the present invention are applicable to all types of hair switches. Further, it has been shown that the results achieved with hair switches are comparable to the results achieved during actual use on people.

The hair sample is prepared as follows:

- 1) Wet hair sample with warm water (38 °C) for 30 seconds.
- 2) Apply 1 ml of ammonium lauryl sulfate solution to the hair sample and lather for 30 seconds.
- 5 3) Rinse the hair sample for 60 seconds.
- 4) Soak the hair sample in warm water for 24 hours.
- 5) Apply 1 ml of ammonium lauryl sulfate solution to the hair sample and lather for 30 seconds.
- 6) Rinse the hair sample for 30 seconds.
- 10 7) Apply 1 ml of ammonium lauryl sulfate solution to the hair sample and lather for 30 seconds.
- 8) Rinse the hair sample for 60 seconds.
- 9) For a treated hair sample: apply 1 ml of a hair care composition to be tested to the hair sample.
- 15 10) For a treated hair sample: rinse off the hair sample for 10 seconds.
- 11) Comb through the front of the hair sample 5 times.
- 12) Comb through the back of the hair sample 5 times.
- 13) Squeeze off excess water from the hair sample and make the cross-section round.
- 20 14) Leave the hair sample in a 21 °C / 65% relative humidity room and dry for 24 hours.
- 15) The hair sample is then ready to be measured by the Image Analysis System.

Steps 9 and 10 are only performed for the treated hair samples. To  
25 compare the effect of a hair care composition on the bulk hair area, flyaway hair area, and total hair area, an "untreated picture" is first taken of a hair sample, and then a "treated picture" is taken. The untreated and treated bulk hair areas, flyaway hair areas, and total hair areas shown in the pictures, are then compared. Typically, the same hair switch is first used for the untreated hair  
30 sample, and then used for the treated hair sample, according to the procedure

described above. Using the same hair switch minimizes sample-to-sample variations.

Once a hair sample (either treated, or untreated), 22, is prepared, it is placed on the sample holder, 16, in front of the white screen, 12. The distance from the high-resolution digital camera, 18, and the hair sample, 22, should be the same for both the untreated and treated pictures. For both the untreated and treated pictures, the hair sample is aligned so that the widest profile (according to the bottom end of the hair sample) is captured by the high-resolution digital camera. This alignment approximates the way hair is arranged on the head, and therefore provides the most accurate view of the effect on hair area (and therefore hair volume), after treatment. This also assures an accurate measurement of the bulk hair area reduction, flyaway hair area reduction, and/or total hair area reduction effects.

Once the hair is essentially motionless, an 8-bit, gray-scale picture is taken with the high-resolution digital camera, 18. Typically, the high-resolution digital camera, 18, assigns each pixel a brightness value of from 0 (pure black) to 255 (pure white). The picture is then transferred to the personal computer, 20. Alternatively, but less preferably, the personal computer may assign each pixel a brightness value from 0 to 255. Such a picture is also referred to as a "captured image," and may be saved electronically as, for example, a TIFF (Tagged Image File Format) file, for future reference. In the captured image, each hair sample appears as gray-to-black on a white background. The imaging software (e.g., Optimas v. 6.2, available from Media Cybernetics of Silver Springs, Maryland, USA) then analyzes the captured image, pixel-by-pixel. The imaging software uses the brightness value assigned to each pixel by the camera to classify each pixel as either black (brightness value = 0 - 120), gray (brightness value = 121 - 235), or white (brightness value = 236 - 255). The imaging software then defines "bulk hair" in the captured image as the largest continuous region bounded by black lines. The "flyaway hair" is defined as black, gray, and white regions bounded by one or more gray lines, excluding the bulk hair. The term "bounded"

as used herein with respect to the imaging software indicates that the referred-to-area is completely surrounded by at least one line of the specified shade.

The imaging software then calculates the area of each region, typically in  $\text{cm}^2$ , to find the bulk hair area and the flyaway hair area. The total hair area is the sum of the bulk hair area and the flyaway hair area. Thus, the bulk hair area and/or the flyaway hair area may also be calculated as a percentage of the total hair area. In a preferred embodiment, the imaging software automatically sets the untreated total hair area equal to a value of 1.0, and normalizes the other values, accordingly. The imaging software may also outline and/or color code the bulk hair area and/or flyaway hair area for easy reference.

The reduction in hair volume after treatment is based on comparing the data obtained from analyzing the treated and untreated hair samples. The hair areas are calculated for the untreated total hair area (UTA), the untreated bulk hair area (UBA), and the untreated flyaway hair area (UFA). These are then compared to the calculated hair areas for the treated total hair area (TTA), the treated bulk hair area (TBA), and the treated flyaway hair area (TFA). The reduction in bulk hair area after treatment corresponds to a reduction in the bulk hair volume, and is calculated according to the following equation:

$$\text{bulk hair area reduction} = 100 * [1 - (TBA/UBA)].$$

Similarly, the percent reduction in flyaway hair area after treatment corresponds to a reduction in the flyaway hair volume, and is calculated according to the following equation:

$$\text{flyaway hair area reduction} = 100 * [1 - (TFA/UFA)].$$

The percent reduction in total hair area after treatment corresponds to a reduction in the total hair volume, and calculated according to the following equation:

$$\text{total hair area reduction} = 100 * [1 - (TTA/UTA)].$$

A given hair care composition (or control) is typically tested on at least three separate hair samples. The bulk hair area reduction, flyaway hair area reduction, and total hair area reduction are then calculated for each hair sample,

and an average bulk hair area reduction, average flyaway hair area reduction, and average total hair area reduction are calculated.

In a preferred embodiment of the Image Analysis Protocol, two pictures of each treated and untreated hair sample are taken. The first picture corresponds to the widest profile of the hair sample, while the second picture corresponds to the most narrow profile of the hair sample, which is typically a 90° rotation from the widest profile. Then, average values are calculated for the untreated bulk hair area, treated bulk hair area, etc. These average values are then employed in the above equations. Such a procedure is especially useful with hair samples which are slightly curved, due to their natural contours, or because of washing.

Examples of the invention are set forth hereinafter by way of illustration and are not intended to be in any way limiting of the invention, as many variations thereof are possible without departing from the spirit and scope of the invention. Ingredients are identified by chemical or CTFA name, or otherwise defined below.

### EXAMPLE 1

Rinse-off hair conditioning compositions are formed according to the following formulations:

	Example A	Example B	Example C	Example D
Cetyl Alcohol *1	2.500	2.500	2.857	2.857
Stearyl Alcohol *2	4.500	4.500	5.143	5.143
Stearamidopropyl dimethylamine *3	2.000	2.000	2.000	2.000
L-Glutamic Acid	0.640	0.640	0.640	0.640
Dimethicone 15/85 *4	-	4.200	-	-
Oleth-5 *5	5.000	2.000	-	-
Oleyl alcohol *6	-	5.000	-	-
PPG-34 *7	-	-	5.000	5.000
Miglyol 812 *8	-	-	-	5.000
Pentaerythritol tetraisostearate *9	-	-	-	1.000
Water, minors	balance	balance	balance	balance
Viscosity (cps)	21500	17300	20500	23900
Volume data (vs. Untreated)				

Bulk hair area reduction %	47	24	11	29
Flyaway hair area reduction %	24	0	48	32
Total hair area reduction %	41	18	20	30

\*1 available from Shin-nihon Rika of Tokyo, Japan

\*2 available from Shin-nihon Rika of Tokyo, Japan

\*3 available from Nikko Chemical, Tokyo, Japan

5 \*4 85%/15% mixture of D5 cyclomethicone and dimethicone gum (weight molecular weight of about 400,000 to about 600,000) from General Electric Co.

\*5 available from Croda, Inc. of Parsippany, New Jersey, USA

\*6 UNJECOL 90BHR available from Shin-nihon Rika of Tokyo, Japan

\*7 New Pol PP-2000 available from Sanyo Kasei, Osaka, Japan; weight average molecular weight = 2,000 g/mol

10 \*8 caprylic/capric triglyceride ester oil available from Degussa-Hüls AG of Frankfurt, Germany

\*9 KAK P.T.I. available from Koukyu Alcohol Kogyo Co. of Chiba Prefecture, Japan

In order to simulate current hair conditioning compositions in the market, dimethicone was added to Example B.

The suitable carrier for Examples A-D is a lamellar gel matrix, which is  
15 formed as follows (all percentages are by weight of the final hair conditioning composition): about 78% deionized water is heated to 85 °C, and 2% Stearamidopropyldimethylamine is mixed with 2.5% cetyl alcohol, 4.5% stearyl alcohol, and 0.64% L-glutamic acid (from Ajinomoto of Osaka, Japan). The aqueous carrier is maintained at a temperature of about 85 °C for about 5  
20 minutes with continuous mixing, until the components are homogenized, and no solids are observed. The aqueous carrier is then gradually cooled to about 55 °C and maintained at this temperature, until a lamellar gel matrix forms.

Example A is formed by mixing the oleth-5 with the lamellar gel matrix at a temperature of about 35 °C. For the other hair conditioning compositions, the  
25 alkoxyate compound (in the case of Examples B-D) and minors (in the case of Examples B-D, and the controls) are mixed with the gel matrix at a temperature of less than about 55 °C, typically less than about 50 °C.

For Example B, a premix is first formed by mixing oleyl alcohol (an oil; available as UNJECOL 90BHR from Shin-nihon Rika of Tokyo, Japan) and oleth-  
30 5 (an alkyl ethoxyate; available as Volpo-5 from Croda, Inc. of Parsippany, New Jersey, USA), at a weight ratio of about 2.5:1. The oleyl alcohol and the oleth-5

are mixed for 10 minutes, at about 22 °C, to form a premix having an HLB value of about 3. This premix is then mixed with the lamellar gel matrix at a weight ratio of premix to lamellar gel matrix of about 1:12, at a temperature of about 50 °C.

- 5 For Examples C and D, the addition of PPG-34 significantly lowers the viscosity of the hair care composition. Thus, the cetyl alcohol and stearyl alcohol levels were adjusted to maintain the viscosity to within the same range as the other examples.

10 As can be seen, Examples A-D provide a significant reduction in bulk hair area, and total hair area. Furthermore, Examples A, C, and D also show a significant reduction in flyaway hair area.

## EXAMPLE 2

15 Hair conditioning compositions of the present invention are formed according to the following formulations. The alkoxylate compound is an alkyl alkoxylate and the suitable carrier is a lamellar gel matrix. In Example F and Example I, the alkoxylate compound was premixed with oleyl alcohol to form a premix having an HLB of about 3. This premix was then added to the lamellar gel matrix, as described above.

Component	E	F	G	H	I	J
Oleth-5 *1	5.0	-	-	-	-	4.0
Oleth-3 *2	-	2.0	-	-	-	1.0
C9-11EO5 *3	-	-	4.0	-	-	-
C9-11EO2.5 *4	-	-	-	10.0	-	-
Steareth-5 *5	-	-	-	-	2.0	-
Steareth-4 *6	-	-	-	-	-	1.0
Stearamidopropyldimethylamine *7	2.0	2.0	-	-	-	1.0
L-Glutamic acid	0.6	-	-	-	-	0.3
Lactic acid	-	1.0	-	-	-	-
Behentrimonium chloride *8	-	-	2.0	-	-	-
Stearyltrimonium chloride *9	-	-	-	2.0	-	-
Cetrimonium chloride *10	-	-	-	-	-	1.0



Distearyldimonium chloride *11	-	-	-	-	2.0	-
Cetyl alcohol *12	2.5	2.4	5.6	1.8	2.0	3.0
Stearyl alcohol *13	4.5	3.6	-	2.7	4.0	5.0
Oleyl alcohol *14	-	5.0	-	-	5.0	-
Cyclomethicone & Dimethicone *15	4.0	-	8.0	3.0	4.0	2.0
Dimethicone/Dimethiconol *16	-	1.0	-	-	-	2.0
Cyclomethicone/Dimethiconol *17	-	-	-	2.0	-	-
PPG-34 *18	2.0	-	-	4.0	-	-
Caprylic/capric triglyceride *19	2.0	-	-	-	-	-
Pentaerythritol tetraisostearate *20	-	1.0	-	-	-	1.0
Mineral oil *21	-	-	2.0	-	-	-
Hexylene Glycol	-	-	-	-	2.0	-
Polyethylene Glycol 200 *22	-	1.0	-	-	-	1.0
2,4-dimethoxy-6-(1'pyrenyl)-1,3,5-triazine *23	-	-	-	-	-	0.5
Porphyrin *24	-	-	-	-	0.5	-
Benzophenone-4 *25	-	-	0.2	-	-	-
Octyl Methoxycinnamate *26	-	0.1	-	1.0	-	-
Vitamin E	-	-	-	-	0.05	-
Panthenol *27	0.1	-	-	-	-	-
Methyl Paraben	0.2	0.2	0.2	0.2	0.2	0.2
Phenoxyethanol	0.3	0.3	0.3	0.3	0.3	0.3
EDTA	0.2	0.1	-	-	0.1	0.2
Disodium EDTA	-	0.1	0.1	0.2	0.1	-
Benzyl alcohol	0.4	0.4	0.5	0.4	0.2	0.40
Perfume	0.2	0.1	0.2	0.2	0.20	0.2
Deionized Water	q.s. to 100%					

#### Definitions of Components

- \*1 Volpo-5 available from Croda
- \*2 Volpo-3 available from Croda
- \*3 Nonidet-LE5 available from Shell
- 5 \*4 Nonidet-LE2.5 available from Shell
- \*5 available from Nikko Chemical, Tokyo, Japan
- \*6 available from Nikko Chemical
- \*7 available from Nikko Chemical
- \*8 Varisoft BT85 available from Witco Chemicals

- \*9 Varisoft TSC available from Witco Chemicals
- \*10 Varisoft CTB40 available from Witco Chemicals
- \*11 Varisoft TA100 available from Witco Chemicals
- \*12 KONOL series available from Shin-nihon Rika
- 5 \*13 KONOL series available from Shin-nihon Rika
- \*14 UNJECOL 90BHR available from Shin-nihon Rika
- \*15 85%/15% mixture of D5 cyclomethicone and dimethicone gum (weight molecular weight of about 400,000 to about 600,000) from General Electric Co.
- \*16 DCQ2-1403 available from Dow Corning
- 10 \*17 DCQ2-1401 available from Dow Corning
- \*18 New Pol PP-2000 available from Sanyo Kasei
- \*19 Miglyol812 available from Degussa-Hüls AG
- \*20 KAK P.T.I. available from Koukyu Alcohol Kogyo Co.
- \*21 BENOL available from Witco Chemicals
- 15 \*22 Carbowax PEG200 available from Union Carbide
- \*23 available from Ciba Geigy
- \*24 available from Wako Chemical
- \*25 Uvnul MS-40 available from BASF
- \*26 Parasol MCX available from Roche
- 20 \*27 available from Roche

### EXAMPLE 3

Hair conditioning compositions of the present invention where the alkoxyate compound is a single-polypropylene glycol-chain segment polymer and/or a multi-polypropylene glycol-chain segment polymer and where the  
 25 suitable carrier is a gel matrix are formed according to the following formulations. In Example K, the suitable carrier is a lamellar gel matrix.

Component	K	L	M	N	O	P
PPG-34 *1	5.0	-	-	-	-	2.0
Polypropylene glycol *2	-	3.0	-	2.0	-	1.0
Polyoxypropylene glyceryl ether *3	-	-	4.0	-	-	-
Polyoxypropylene sorbitol *4	-	-	-	3.0	-	-
PPG-10 butanediol *5	-	-	-	-	2.0	1.0
Cetyl hydroxyethyl cellulose *6	0.25	-	-	-	-	0.25
Oleyl alcohol *7	-	-	-	1.0	-	1.0

Caprylic/capric triglyceride *8	5.0	5.0	3.0	-	5.0	-
Pentaerythritol tetraisostearate *9	1.0	1.0	1.0	-	-	-
Mineral oil *10	-	-	1.0	-	1.0	-
Stearamidopropyldimethylamine *11	2.0	2.0	-	-	-	1.0
L-Glutamic acid	0.6	-	-	-	-	0.3
Lactic acid	-	1.0	-	-	-	-
Behentrimonium chloride *12	-	-	2.0	-	-	-
Stearyltrimonium chloride *13	-	-	-	2.0	-	-
Cetrimonium chloride *14	-	-	-	-	-	1.0
Distearyldimonium chloride *15	-	-	-	-	2.0	-
Cetyl alcohol *16	2.5	2.4	5.6	1.8	2.0	3.0
Stearyl alcohol *17	4.5	3.6	-	2.7	4.0	5.0
Cyclomethicone & Dimethicone *18	4.0	-	8.0	3.0	4.0	2.0
Dimethicone/Dimethiconol *19	-	1.0	-	-	-	2.0
Cyclomethicone/Dimethiconol *20	-	-	-	2.0	-	-
Hexylene Glycol	-	-	-	-	2.0	-
Polyethylene Glycol 200 *21	-	1.0	-	-	-	1.0
2,4-dimethoxy-6-(1'pyrenyl)-1,3,5-triazine *22	-	-	-	-	-	0.5
Porphyrin *23	-	-	-	-	0.5	-
Benzophenone-4 *24	-	-	0.2	-	-	-
Octyl Methoxycinnamate *25	-	0.1	-	1.0	-	-
Vitamin E	-	-	-	-	0.05	-
Panthenol *26	0.1	-	-	-	-	-
Methyl Paraben	0.2	0.2	0.2	0.2	0.2	0.2
Phenoxyethanol	0.3	0.3	0.3	0.3	0.3	0.3
EDTA	0.2	0.1	-	-	0.1	0.2
Disodium EDTA	-	0.1	0.1	0.2	0.1	-
Benzyl alcohol	0.4	0.4	0.5	0.4	0.2	0.40
Perfume	0.2	0.1	0.2	0.2	0.20	0.2
Deionized Water	q.s. to 100%					

#### Definitions of Components

\*1 New Pol PP-2000 available from Sanyo Kasei

\*2 New Pol PP-4000 available from Sanyo Kasei, weight average molecular weight = 4000.

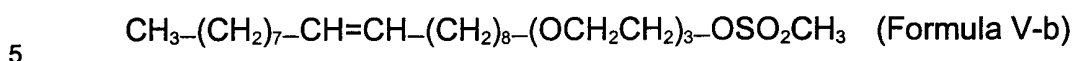
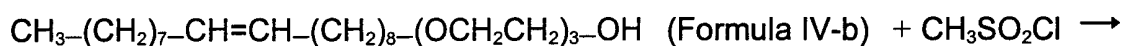
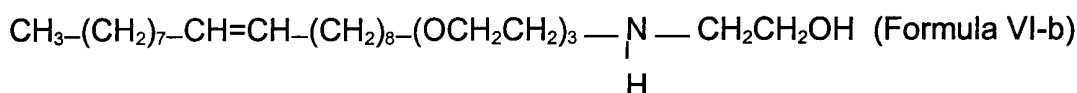
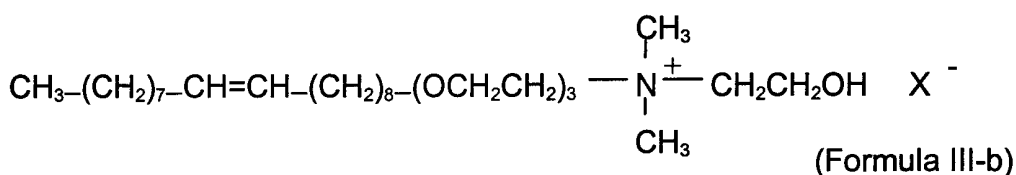
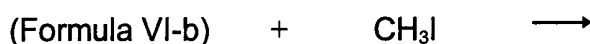
\*3 New Pol GP-4000 available from Sanyo Kasei

5 \*4 New Pol SP-4000 available from Sanyo Kasei

- \*5 Probutyl DB-10 available from Croda, Inc.
- \*6 NATROSOL PLUS 330CS from Aqualon Co., Delaware, USA.
- \*7 UNJECOL 90BHR available from Shin-nihon Rika
- \*8 Miglyol812 available from Degussa-Hüls AG
- 5 \*9 KAK P.T.I. available from Koukyu Alcohol Kogyo Co. of Chiba Prefecture, Japan
- \*10 BENOL available from Witco Chemicals, Greenwich, Connecticut, USA
- \*11 available from Nikko Chemical, Tokyo, Japan
- \*12 Varisoft BT85 available from Witco Chemicals
- \*13 Varisoft TSC available from Witco Chemicals
- 10 \*14 Varisoft CTB40 available from Witco Chemicals
- \*15 Varisoft TA100 available from Witco Chemicals
- \*16 KONOL series available from Shin-nihon Rika
- \*17 KONOL series available from Shin-nihon Rika
- \*18 85%/15% mixture of D5 cyclomethicone and dimethicone gum (weight molecular weight of  
15 about 400,000 to about 600,000) from General Electric Co.
- \*19 DCQ2-1403 available from Dow Corning
- \*20 DCQ2-1401 available from Dow Corning
- \*21 Carbowax PEG200 available from Union Carbide
- \*22 available from Ciba Geigy
- 20 \*23 available from Wako Chemical, Osaka, Japan
- \*24 Uvnul MS-40 available from BASF
- \*25 Parasol MCX available from Roche
- \*26 available from Roche

## EXAMPLE 4

A cationic alkyl alkoxyate derivative of Formula III-b is obtained by a synthesis route as shown in the following scheme:

ActivationNucleophilic substitutionQuaternizationActivation

A 0.58 mole portion of mesyl chloride is added dropwise to an ice-cooled stirring solution of 0.446 mole starting material of Formula IV-b and 0.58 mole triethylamine in 600 ml of abs. dehydrated benzene. The reaction solution is stirred for 1 hour under ice-cooling and for 1 day at room temperature. After filtration to remove solid triethylamine hydrochloride, 200 ml of aq. sat.  $\text{NaHCO}_3$  sol. is added to the solution to react with the remaining mesyl chloride and the solution is stirred for 2 hours. The solution is separated into the organic and water phases. The organic phase is collected by extracting the water phase by 200 ml of benzene. The organic phase is dried by  $\text{Na}_2\text{SO}_4$  for 1 day. The solvent is evaporated to obtain the liquid compound of Formula V-b.

Nucleophilic substitution

A 1.78 mole portion of nucleophile (ethanol amine), 23.6 g of  $\text{Na}_2\text{CO}_3$ , and 600 ml of ethanol are added to 0.425 mole of the obtained compound of Formula V-b. The reaction solution is stirred for 1 day at  $85^\circ\text{C}$ . The solvent is evaporated, and the syrup is washed with 300 ml of water. A 5 g portion of  $\text{Na}_2\text{CO}_3$  is added to the water solution to make it alkaline ( $\text{pH} > 12$ ) and  $\text{Na}_2\text{SO}_4$  is also added to saturate the solution for phase separation. The washing step using  $\text{Na}_2\text{CO}_3$  and saturating step using  $\text{Na}_2\text{SO}_4$  are repeated for a total of 3 times. A gel material is collected, and the water of the gel material is evaporated to obtain the liquid compound of Formula VI-b.

#### 10 Quaternization

A 86.3 g portion of  $\text{Na}_2\text{CO}_3$  and 600 ml of ethanol are added to 0.407 mole of the obtained compound of Formula VI-b with stirring. Quaternizing agent (methyl iodide) is added dropwise to an ice-cooled stirring solution. The reaction solution is stirred for 6 hours at  $40^\circ\text{C}$  and for 1 day at  $80^\circ\text{C}$ . The solvent is evaporated, and the syrup is washed with 500 ml of water.  $\text{Na}_2\text{SO}_4$  is added to the water solution to saturate the solution for phase separation. The washing step using  $\text{Na}_2\text{CO}_3$  and saturating step using  $\text{Na}_2\text{SO}_4$  are repeated for a total of 3 times. A gel material is collected, and the water of the gel materials is evaporated. Ethanol is added to extract the compound of Formula III-b separating from residual salt. The ethanol is evaporated, and the liquid compound of Formula III-b is obtained.

Component	Q
Cationic alkyl alkoxylate (of Formula III-b, above)	2.0
Cetyl alcohol *1	2.5
Stearyl alcohol *2	4.5
Disodium EDTA	0.1
Benzyl alcohol	0.4
Deionized Water	q.s. to 100%

Definition of Components

\*1 KONOL series available from Shin-nihon Rika

\*2 KONOL series available from Shin-nihon Rika

5

## EXAMPLE 5

Hair conditioning compositions of the present invention are formed according to the following formulations. The alkoxylate compound is an alkyl alkoxylate and the suitable carrier is water. For Examples R and S, a first pre-  
 10 mix of the Polyquaternium 10 in water is prepared while heating to 30°C, and then, once dispersed, heating to 82°C. Next cetyl alcohol, methylparaben, propylparaben, PEG-60 and CTMAC are added to the first premix while maintaining the temperature above 80°C. These ingredients are mixed and then cooled to 30°C. A second premix containing water, disodium EDTA, DL-  
 15 panthenol and citric acid is separately prepared. Once the first premix has been cooled to 30°C, the second premix is added to the first pre-mix along with the rest of the ingredients. This mixture is then mixed, the pH adjusted if necessary, and cooled.

Component	R	S
Water	q.s.	q.s.
Polyquaternium 10 *1	0.21	0.21
Cetyl Alcohol	2.11	2.11
Methylparaben	0.2	0.2
Propylparaben	0.1	0.1
PEG-60 Hydrogenated Castor Oil *2	0.2	0.2
CTMAC *3	0.5	0.5
PPG-34 *4	4	0
Oleth-5 *5	0	4
Citric Acid Anhydrous	0.025	0.025
Disodium EDTA	0.11	0.11

Panthenol-DL *6	0.06	0.06
DMDM Hydantoin	0.2	0.2
Panthenyl Ethyl Ether-DL *7	0.54	0.54
Perfume	0.5	0.5
Styryl Silicone *8	0.2	0.2

Definitions of Components

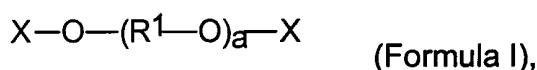
- \*1 Ucare KG30M available from Amerchol
- \*2 Cremophor RH60 available from BASF
- \*3 DequartA available from Henkel
- 5 \*4 Polyol PPG 2000 available from Lynodell
- \*5 Volpo 5 available from Croda, Inc.
- \*6 D-Panthenol
- \*7 Pantyl
- \*8 Styryl MQ Silicone available from GE Silicones



## WHAT IS CLAIMED IS:

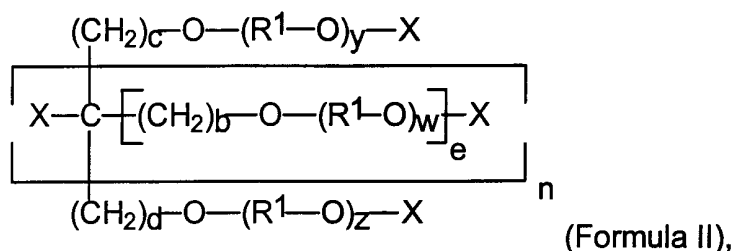
1. A hair care composition comprising, by weight of the hair care composition:

- A. from about 0.01% to about 99% of an alkoxylate compound having an HLB value of from about 5 to about 12, the alkoxylate compound being selected from the group consisting of a single-alkoxylate-chain segment polymer, a multi-alkoxylate-chain segment polymer, a cationic alkyl alkoxylate derivative, and mixtures thereof, wherein the single-alkoxylate-chain segment polymer is of the formula:



wherein each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>30</sub> alkyl groups, wherein each R<sup>1</sup> is independently a C<sub>2</sub>-C<sub>4</sub> alkyl group, and wherein a is a value from about 1 to about 400; and

wherein the multi-alkoxylate-chain segment polymer is of the formula:



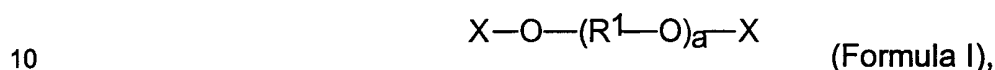
wherein each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>30</sub> alkyl groups, wherein each R<sup>1</sup> is independently a C<sub>2</sub>-C<sub>4</sub> alkyl group, wherein n is a value from about 1 to about 10, wherein each b is independently a value from about 0 to about 2, wherein c and d are independently a value from about 0 to about 2, wherein b + c + d is at least about 2, wherein each e is independently a value of 0 or 1,

25 and wherein each w, y, and z is independently a value from  
about 1 to about 120; and

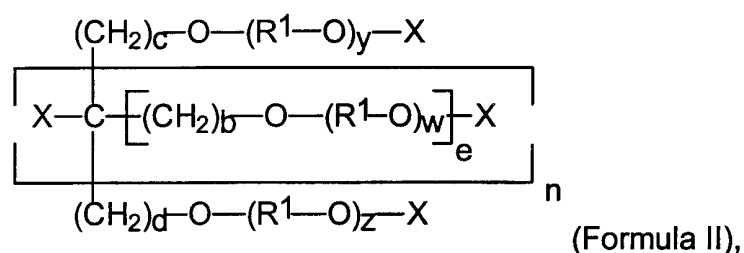
B. from about 1% to about 99.99% of a suitable carrier,  
wherein the hair care composition reduces bulk hair area by at least about  
10%, as measured by an Image Analysis Protocol.

2. The hair care composition of Claim 1, wherein the alkoxyate compound is selected from the group consisting of an alkyl alkoxyate, a single-polypropylene glycol-chain segment polymer, a multi-polypropylene glycol-chain segment polymer, and mixtures thereof.
3. The hair care composition of Claim 1, wherein the alkoxyate compound is a single-alkoxyate-chain segment polymer.
4. The hair care composition of Claim 1 further comprising a cationic material selected from the group consisting of cationic polymers, cationic polysaccharide polymers, and mixtures thereof, wherein the cationic material has a charge density in the range from about 1.5 meq/g to about 5 meq/g.
5. The hair care composition of Claim 1, wherein the alkoxyate compound is a multi-alkoxyate-chain segment polymer.
6. The hair care composition of Claim 1, wherein the alkoxyate compound has an HLB of from about 6 to about 11.
7. The hair care composition of Claim 1, wherein the suitable carrier comprises a gel matrix comprising a cationic surfactant, a solid fatty alcohol, and water.
8. The hair care composition of Claim 1, wherein the alkoxyate compound comprises from about 0.1% to about 20% of the hair care composition, by weight.
9. The hair care composition of Claim 1, wherein the hair care composition further reduces flyaway hair area by at least about 25%, as measured by the Image Analysis Protocol.

10. The hair care composition of Claim 4 wherein the cationic material is a cationic polysaccharide polymer selected from the group consisting of cationic polymers and copolymers of cellulose derivatives.
11. The hair care composition of Claim 10 wherein the cationic polysaccharide polymer comprises from about 0.001% to about 20% of the hair care composition.
12. A method for reducing bulk hair area comprising the steps of:
  - A. providing hair having a bulk hair area;
  - B. applying an effective amount of the hair care composition according to any of the above claims to the hair having a bulk hair area; and
  - 5 C. drying the hair.
13. The method of Claim 12, further comprising the step of rinsing the hair after the applying step.
14. A hair care composition comprising, by weight of the hair care composition:
  - A. from about 0.01% to about 99% of an alkoxylate compound having an HLB value of from about 5 to about 12, the alkoxylate compound being selected from the group consisting of a single-alkoxylate-chain segment polymer, a multi-alkoxylate-chain segment polymer, a cationic alkyl alkoxylate derivative, and mixtures thereof,
    - 5 wherein the single-alkoxylate-chain segment polymer is of the formula:



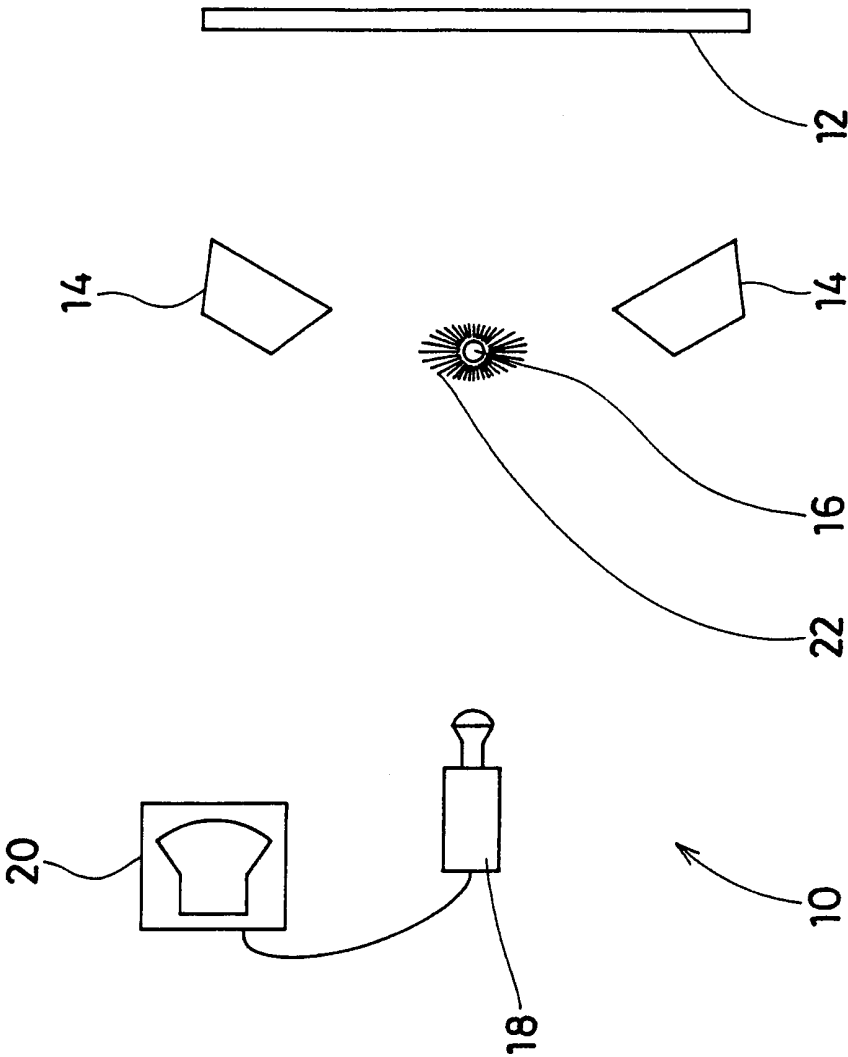
- 10 wherein each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>30</sub> alkyl groups, wherein each R<sup>1</sup> is independently a C<sub>2</sub>-C<sub>4</sub> alkyl group, and wherein a is a value from about 1 to about 400; and
- 15 wherein the multi-alkoxylate-chain segment polymer is of the formula:



wherein each X is independently selected from the group consisting of H, and C<sub>1</sub>-C<sub>30</sub> alkyl groups, wherein each R<sup>1</sup> is independently a C<sub>2</sub>-C<sub>4</sub> alkyl group, wherein n is a value from about 1 to about 10, wherein each b is independently a value from about 0 to about 2, wherein c and d are independently a value from about 0 to about 2, wherein b + c + d is at least about 2, wherein each e is independently a value of 0 or 1, and wherein each w, y, and z is independently a value from about 1 to about 120; and

- B. a cationic material selected from the group consisting of cationic polymers, copolymers of saccharides and mixtures thereof, wherein the cationic material has a charge density in the range from about 1.5 meq/g to about 5 meq/g; and
- C. from about 1% to about 99.99% of a suitable carrier.
15. The hair care composition of Claim 14 wherein the cationic material is a cationic polysaccharide polymer selected from the group consisting of cationic polymers and copolymers of cellulose derivatives.
16. The hair care composition of Claim 15 wherein the cationic polysaccharide polymer comprises from about 0.001% to about 20% of the hair care composition.

Fig. 1



# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 99/20334

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 7 A61K7/06		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) IPC 7 C08G C08L 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 practical, search terms used)  EPO-Internal WPI PAJ		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 196 29 951 A (BEIERSDORF AG) 29 January 1998 (1998-01-29) claims 1-4	1-3, 8, 12, 14
X	US 5 641 480 A (VERMEER ROBERT) 24 June 1997 (1997-06-24) claim 1; examples 114, 115, 127, 128	1-3, 5-8, 12, 14
X	US 5 942 216 A (SUN WEI MEI ET AL) 24 August 1999 (1999-08-24) claims 1-55; examples 1-28	1-4, 6-8, 12-14
X	EP 0 312 995 A (KAO CORP) 26 April 1989 (1989-04-26) claims 1-7	1, 2, 5, 6, 8, 12, 14
<div style="display: flex; justify-content: space-between;"> <span><input type="checkbox"/> Further documents are listed in the continuation of box C.</span> <span><input checked="" type="checkbox"/> Patent family members are listed in annex.</span> </div>		
* Special categories of cited documents :		
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"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</p> <p>"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</p> <p>"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.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
Date of the actual completion of the international search  <div style="text-align: center; font-weight: bold;">24 May 2000</div>		Date of mailing of the international search report  <div style="text-align: center; font-weight: bold;">02/06/2000</div>
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016		Authorized officer  <div style="text-align: center; font-weight: bold;">Stienon, P</div>

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Information on patent family members

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