

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property

Organization

International Bureau

(43) International Publication Date

16 November 2017 (16.11.2017)



(10) International Publication Number

WO 2017/197099 A1

(51) International Patent Classification:

A61K 8/362 (2006.01)

A61Q 5/10 (2006.01)

A61K 8/365 (2006.01)

Published:

— with international search report (Art. 21(3))

(21) International Application Number:

PCT/US2017/032140

(22) International Filing Date:

11 May 2017 (11.05.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

15/153,084

12 May 2016 (12.05.2016)

US

15/153,154

12 May 2016 (12.05.2016)

US

(71) Applicant (for all designated States except AL): L'OREAL
[FR/FR]; 14 Rue Royale, 75008 Paris (FR).

(72) Inventors; and

(71) Applicants (for all designated States except AL): SINGER,
Jim [US/US]; 111 Terminal Avenue, Clark, NJ 07066 (US).
NGUYEN, Nghi, Van [US/US]; 111 Terminal Avenue,
Clark, NJ 07066 (US).

(74) Agent: BALLS, R., James; Polsinelli PC, 1401 Eye Street,
N.W., Suite 800, Washington, DC 20005 (US).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR,
KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

(54) Title: METHODS AND COMPOSITIONS FOR IMPROVING THE QUALITY AND DURABILITY OF COLOR IN ARTIFICIALLY COLORED HAIR

(57) Abstract: The present disclosure relates to compositions and methods for improving the quality and durability of color in artificially colored hair. The methods employ alkaline earth metal salts that act as a mordant (a fixing agent) with hair dye and hydroxy-polycarboxylic acids or salts of hydroxy-polycarboxylic acids, which act as chelators. Methods are described wherein the alkaline earth metal salts, hydroxy-polycarboxylic acids, and salts of hydroxy-polycarboxylic acids are used in a pre-color treatment (a treatment to the hair prior to artificial coloring), used as part of a coloring composition, and used in a post-color treatment (a treatment to the hair after artificial coloring).



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TITLE

METHODS AND COMPOSITIONS FOR IMPROVING THE QUALITY AND DURABILITY OF COLOR IN ARTIFICIALLY COLORED HAIR

FIELD OF THE DISCLOSURE

5 The present disclosure relates to compositions and methods for providing color protection to hair, in particular, for improving the quality and durability of color in artificially colored hair. The methods employ alkaline earth metal salts that act as a mordant (a fixing agent) with dyes, and hydroxy-polycarboxylic acids and salts of hydroxy-polycarboxylic acids, which act as chelators.

BACKGROUND

10 There are many products available for changing the natural color of hair. The process of changing the color of hair can involve either depositing an artificial color onto the hair, which provides a different shade or color to the hair, or lifting the color of the hair, such as for example, from a dark brown shade to a medium brown or a
15 light brown shade. Hair color can be changed using permanent, semi-permanent, or temporary hair coloring products.

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

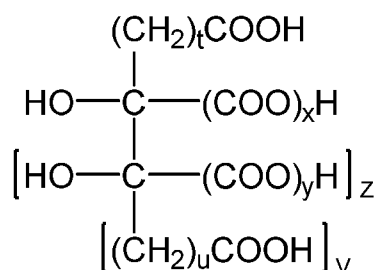
30 Newly, permanently colored hair usually has a vibrant, shiny, and rich appearance. Unfortunately, however, in just a few short weeks, or in some cases

even less, the color begins to fade due to washing or exposure to environmental conditions. For instance, gorgeous rich brown colors become muddy and dull, beautiful shades of blonde turn brassy, and vibrant reds do not look so vibrant anymore acquiring golden, orange or brownish tonalities not desirable to the consumer. As described herein, the inventors of the instant disclosure have developed methods and kits that improve color durability by preventing color fading from hair.

SUMMARY OF THE DISCLOSURE

The present disclosure relates to improving the quality and durability of the color in artificially colored hair. The methods described herein employ alkaline earth metal salts that act as a mordant (a fixing agent) with hair dye and hydroxy-polycarboxylic acids and salts of hydroxy-polycarboxylic acids, which act as chelators. When both of these components are used in the methods described herein, color quality and color durability are improved.

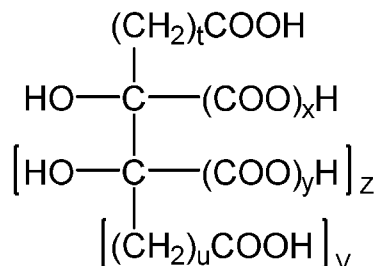
In one aspect, methods for artificially coloring hair and inhibiting the coloring from fading involve: (a) treating hair with a pre-color treatment composition comprising one or more alkaline earth metal salts or one or more salts of a hydroxy-polycarboxylic acid, wherein hydroxy-polycarboxylic acid has the formula:



wherein, x and y are independently 0 or 1; and
t, u, v, and z are independently 0 to 3; and

(b) treating the hair with a coloring composition comprising the one or more alkaline earth metal salts or the one or more salts of a hydroxy-polycarboxylic acid; provided that when the one or more alkaline earth metal salts is used in the pre-color treatment composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the coloring composition, and vice versa.

In another aspect, methods for artificially coloring hair and inhibiting the coloring from fading involve: (a) treating hair with a pre-color treatment composition comprising one or more alkaline earth metal salts or one or more salts of a hydroxy-polycarboxylic acid of the formula

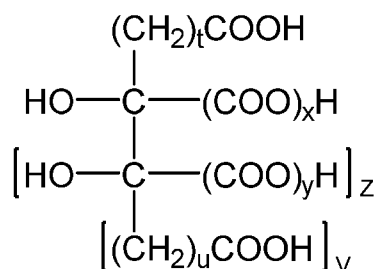


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wherein, x and y are independently 0 or 1; and
t, u, v, and z are independently 0 to 3; and

(b) treating the hair with a coloring composition; and (c) treating the hair with a post-color treatment composition comprising the one or more alkaline earth metal salts or the one or more salts of a hydroxy-polycarboxylic acid; provided that when the one or more alkaline earth metal salts is used in the pre-color treatment composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the post-color treatment composition, and vice versa.

In yet another aspect, methods for artificially coloring hair and inhibiting the coloring from fading involve: (a) treating the hair with a coloring composition comprising one or more alkaline earth metal salts one or more salts of a hydroxy-polycarboxylic acid, wherein hydroxy-polycarboxylic acid has the formula:



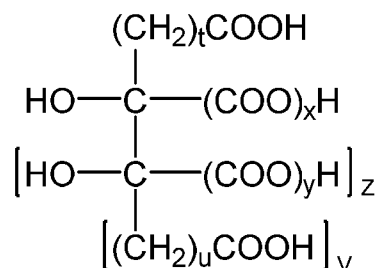
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wherein, x and y are independently 0 or 1; and
t, u, v, and z are independently 0 to 3; and

(b) treating the hair with a post-color treatment composition comprising the one or more alkaline earth metal salts or the one or more salts of a hydroxy-

polycarboxylic acid; provided that when the one or more alkaline earth metal salts is used in the coloring composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the post-color treatment composition, and vice versa.

In another aspect, methods for inhibiting color fading of artificially colored hair involve applying to the artificially colored hair a post-color treatment composition comprising one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids of the formula



wherein, x and y are independently 0 or 1; and

t, u, v, and z are independently 0 to 3.

The present disclosure also relates to methods for artificially coloring hair and inhibiting the coloring from fading, the methods comprising: (a) treating hair with a coloring composition comprising one or more alkaline earth metal salts (an in-color treatment composition) and coloring the hair; and (b) subsequently treating the hair with a post-color treatment composition comprising one or more hydroxy-polycarboxylic acids.

Examples of of hydroxy-polycarboxylic acids include, but are not limited to, citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and 2-hydroxy n-butyl 1,3,4-tricarboxylic acid. In some cases, the hydroxy-polycarboxylic acid is citric acid.

The one or more salts of the hydroxy-polycarboxylic acid are typically alkali metal salts, alkaline earth metal salts, and/or transition metal salts. Non-limiting examples of salts of the hydroxy-polycarboxylic acid include salts of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and/or 2-hydroxy n-butyl 1,3,4-tricarboxylic acid.

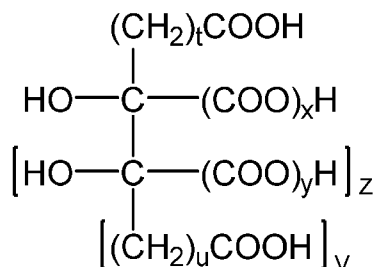
Non-limiting examples of alkaline earth metal salts include magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium

carbonate and hydrogencarbonate, magnesium phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate.

Finally, the instant disclosure relates to kits comprising the various compositions used to carry out the methods described herein. The kits may be used by hair-care professionals and salons for treating the hair of patrons or the kits may be purchased and used at home directly by consumers.

DETAILED DESCRIPTION OF THE DISCLOSURE

Alkaline earth metal salts and salts of hydroxy-polycarboxylic acids can be used in pre-color treatment, in coloring treatment, and in post-color treatment compositions to improve the quality of hair color and to prevent the color from fading. In one aspect, methods for artificially coloring hair and inhibiting the coloring from fading involve: (a) treating hair with a pre-color treatment composition comprising about 1 wt.% to about 75 wt.% of one or more alkaline earth metal salts or about 1 wt.% to about 75 wt.% of one or more salts of a hydroxy-polycarboxylic acid, wherein hydroxy-polycarboxylic acid has the formula:

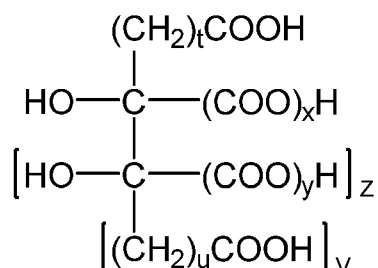


wherein, x and y are independently 0 or 1; and

t, u, v, and z are independently 0 to 3; and

(b) treating the hair with a coloring composition comprising about 1 wt.% to about 50 wt.% of the one or more alkaline earth metal salts or about 1 wt.% to about 50 wt.% of the one or more salts of a hydroxy-polycarboxylic acid; provided that when the one or more alkaline earth metal salts is used in the pre-color treatment composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the coloring composition, and vice versa.

In another aspect, methods for artificially coloring hair and inhibiting the coloring from fading involve: (a) treating hair with a pre-color treatment composition comprising about 1 wt.% to about 75 wt.% of one or more alkaline earth metal salts or about 1 wt.% to about 75 wt.% of one or more salts of a hydroxy-polycarboxylic acid of the formula

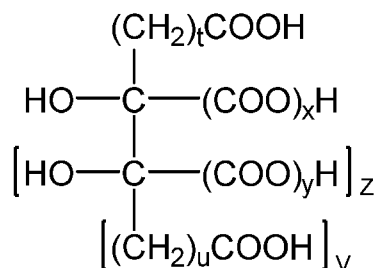


wherein, x and y are independently 0 or 1; and

t, u, v, and z are independently 0 to 3; and

(b) treating the hair with a coloring composition; and (c) treating the hair with a post-color treatment composition comprising about 1 wt.% to about 75 wt.% of the one or more alkaline earth metal salts or about 1 wt.% to about 75 wt.% of the one or more salts of a hydroxy-polycarboxylic acid; provided that when the one or more alkaline earth metal salts is used in the pre-color treatment composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the post-color treatment compositions, and vice versa.

In yet another aspect, methods for artificially coloring hair and inhibiting the coloring from fading involve: (a) treating the hair with a coloring composition comprising about 1 wt.% to about 50 wt.% of one or more alkaline earth metal salts or about 1 wt.% to about 50 wt.% of one or more salts of a hydroxy-polycarboxylic acid, wherein hydroxy-polycarboxylic acid has the formula:



wherein, x and y are independently 0 or 1; and

t, u, v, and z are independently 0 to 3; and

(b) treating the hair with a post-color treatment composition comprising about 1 wt.% to about 75 wt.% of the one or more alkaline earth metal salts or about 1 wt.% to about 75 wt.% of the one or more salts of a hydroxy-polycarboxylic acid; provided that when the one or more alkaline earth metal salts is used in the coloring composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the post-color treatment composition, and vice versa.

The one or more salts of the hydroxy-polycarboxylic acid are typically alkali metal salts, alkaline earth metal salts, and/or transition metal salts. Non-limiting examples of salts of the hydroxy-polycarboxylic acid include salts of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and/or 2-hydroxy n-butyl 1,3,4-tricarboxylic acid. In some cases, sodium citrate salts are used, such as trisodium citrate.

Non-limiting examples of alkaline earth metal salts include magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate. In some cases, calcium chloride is used.

The total amount of the one or more salts of the hydroxy-polycarboxylic acid or the one or more alkaline earth metal salts, when used in a pre-color treatment composition, is about 1 wt.% to about 75 wt.%, based on the total weight of the pre-color treatment composition. The total amount of the one more salts may be from about 1 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 5 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 10 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 15 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about

40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 20 wt.% to about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 25 wt.% to about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 30 wt.% to about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%.

The total amount of the one or more salts of the hydroxy-polycarboxylic acid or the one or more alkaline earth metal salts, when used in a coloring composition, is about 1 wt.% to about 50 wt.%, based on the total weight of the coloring composition. The total amount of the one or more salts may be from about 1 wt.% to about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%. The total amount of the one or more salts may be from about 5 wt.% to about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%. The total amount of the one or more salts may be from about 10 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%. The total amount of the one or more salts may be from about 15 wt.% to about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%. The total amount of the one or more salts may be from about 20 wt.% to about 40 wt.%, about 45 wt.%, or about 50 wt.%.

The total amount of the one or more salts of the hydroxy-polycarboxylic acid or the one or more alkaline earth metal salts, when used in a post-color treatment composition, is about 1 wt.% to about 75 wt.%, based on the total weight of the post-color treatment composition. The total amount of the one more salts may be from about 1 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 5 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 10 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%.

60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 15 wt.% to about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 20 wt.% to about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 25 wt.% to about 40 wt.%, about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%. The total amount of the one more salts may be from about 30 wt.% to about 45 wt.%, about 50 wt.%, about 55 wt.%, about 60 wt.%, about 65 wt.%, or about 70 wt.%.

The pre-color treatment compositions described herein are applied to the hair before applying the coloring composition. The pre-color treatment compositions are applied to the hair in a sufficient amount to cover the hair and are allowed to remain on the hair for a period of time. The pre-color treatment compositions are typically applied to the hair at room temperature (about 15°C to about 25°C) and allowed to at least briefly remain on the hair. For example, the pre-color treatment compositions may be allowed to remain on the hair for at least about 1, about 2, about 5, about 10, about 15, about 20, about 25, or about 30 minutes after application, or up to about 1 or about 2 hours, until the hair is subsequently colored. Further, the pre-treatment composition may be applied and allowed to remain on the hair for 1 to 30 minutes at room temperature (about 15°C to about 25°C). The post-color treatment compositions may be applied at higher temperatures, for example, at temperatures from about 20°C to about 45°C, about 25°C to about 45°C, about 30°C to about 45°C. The compositions may be applied to the hair at one temperature, and then the hair containing the compositions may be warmed during treatment. Further, post-color treatment composition may be applied to the hair, and allowed to naturally dry on the hair, or a drying step may be included using heat and/or air (e.g., blow drying) to dry the composition onto the hair.

The pre-color treatment compositions may be applied to dry hair and allowed to remain on the hair for sufficient amount of time to absorb throughout the hair, and may optionally be dried onto the hair. For example, the hair may be blown dry after application of the pre-color treatment composition. The pre-color treatment

composition may or may not be removed, e.g., by shampooing, prior to application of a coloring composition.

The coloring compositions described herein may be applied to the hair after application of a pre-color treatment composition in cases where a pre-color treatment composition is employed (as described above). The coloring compositions are typically applied to the hair within about 24 hours after treatment with the pre-color treatment composition, of within about 2 hours, about 1 hour, about 30 min, about 15 min, or about 5 min.

The coloring compositions are allowed to remain on the hair for a sufficient amount of time to adequately color the hair, as is well known in the art. For example, the coloring composition may be allowed to remain on the hair for 1 to 60 minutes at a temperature of 20 to 45°C. Typically, the coloring composition is allowed to remain on the hair for at least about 1 min., about 2 min., about 5 min., about 10 min., about 15 min., about 20 min., about 25 min., about 30 min. and may remain on the hair for up to about 1 hour, 1.5 hours, 2 hours, or longer. The amount of time that the coloring composition is allowed to remain on the hair often depends on the strength of the coloring composition, the original color and strength of the hair being colored, and the degree of color change desired. The coloring compositions may optionally be warmed upon application to the hair, for example, from a temperature of about 25°C, about 30°C, about 35°C, or higher, up to a temperature of about 40°C, or higher. The warming may expedite the coloring process. Typically, after the coloring process is complete, the coloring composition is removed, for example, by shampooing, prior to application of a post-color treatment composition (in situations where a post-color treatment composition is applied). The colored hair may optionally be dried prior to application of a post-color treatment composition.

Typically, the post-color treatment composition is applied to the hair after the hair is colored, e.g., within 24 hours. Often, the post-color treatment composition is applied to the hair immediately after artificially coloring the hair, for example, within about 1 min., about 5 min., about 10 min., about 15 min., about 30 min., about 1 hour, or about 2 hours after artificially coloring the hair. The post-color treatment compositions described herein may be applied once, or may be applied multiple times. For example, the post-color treatment compositions may be applied daily,

weekly, monthly, or applied during the time of washing the hair. The post-color treatment compositions may be “stand-alone” products or may be formulated as another cosmetic product that is applied to the hair, thereby creating a multi-purpose product. For example, the post-color treatment compositions may be formulated as
5 a pre- or post- shampooing treatment or “rinse” product, it may be formulated as a conditioner, which is typically applied to the hair immediately after shampooing. It may be formulated as an “over-night” treatment to be applied to the hair and allowed to remain on the hair while the consumer sleeps.

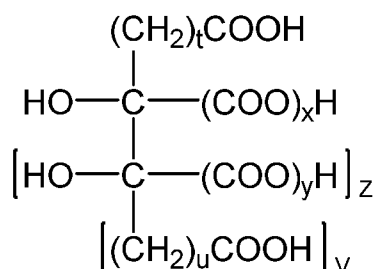
The post-color treatment compositions may be applied to the hair at room
10 temperature (about 15°C to about 25°C). Further, the post-color treatment compositions may be applied at higher temperatures, for example, at temperatures from about 20°C to about 45°C, about 25°C to about 45°C, about 30°C to about 45°C. The compositions may be applied to the hair at one temperature, and then the hair containing the compositions may be warmed during treatment. Further, post-
15 color treatment composition may be applied to the hair, and allowed to naturally dry on the hair, or a drying step may be included using heat and/or air (e.g., blow drying) to dry the composition onto the hair.

The coloring compositions of the present disclosure typically comprise at least one colorant compound chosen from oxidative dye precursors, direct dyes,
20 pigments, and mixtures thereof. The oxidation dyes are generally chosen from one or more oxidation bases optionally combined with one or more couplers. The coloring composition may include an oxidation agent. In many cases an oxidative agent is combined with the coloring compositions immediately prior to treating hair with the coloring treatment.

25 Further, the instant disclosure relates to kits comprising the compositions described above, including the pre-color treatment compositions, the coloring compositions and the post-color treatment compositions. Each of the kits may also optionally include an oxidizing agent or a composition comprising an oxidizing agent. Often, the kits are accompanied by instructions for use, and may also optionally
30 include utensils for mixing, applying, and maintaining the compositions.

In another embodiment, the instant disclosure relates to compositions and methods for inhibiting color fading of artificially colored hair, the methods typically

involve applying to the artificially colored hair a post-color treatment composition comprising one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids of the formula:



5 wherein, x and y are independently 0 or 1; and
 t, u, v, and z are independently 0 to 3.

Examples of alkaline earth metal salts that may be employed include, but are not limited to magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium
 10 phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate. In some cases the alkaline earth metal salt is calcium chloride.

Examples of of hydroxy-polycarboxylic acids include, but are not limited to, citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-
 15 tricarboxylic acid, glucaric acid, and 2-hydroxy n-butyl 1,3,4-tricarboxylic acid. In some cases, the hydroxy-polycarboxylic acid is citric acid.

The total amount of the one or more alkaline earth metal salts in the post-color treatment composition may be from about 1 wt.% to about 50 wt.%, based on the total weight of the post-color treatment composition. In some cases, the total
 20 amount of the one or more alkaline earth metal salts is from about 1 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, or about 45 wt.%. Likewise, in some cases the total amount of the one or more alkaline earth metal salts is from about 5 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about
 25 40 wt.%, about 45 wt.%, or about 50 wt.%. Furthermore, in some cases the total amount of the one or more alkaline earth metal salts is from about 10 wt.% to about

20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%.

The total amount of the one or more hydroxy-polycarboxylic acids in the post-color treatment composition may be from about 1 wt.% to about 50 wt.%, based on the total weight of the post-color treatment composition. In some cases, the total amount of the one or more hydroxy-polycarboxylic acids is from about 1 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, or about 45 wt.%. Likewise, in some cases the total amount of the one or more hydroxy-polycarboxylic acids is from about 5 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%. Furthermore, in some cases the total amount of the one or more hydroxy-polycarboxylic acids is from about 10 wt.% to about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%.

The one or more alkaline earth metal salts and the one or more hydroxy-polycarboxylic acids are typically in the same post-color treatment composition for ease of use, but may be provided as separate post-color treatment compositions. The separate compositions may be applied simultaneously to the artificially colored hair or may be sequentially applied to the artificially colored hair. In both cases, the composition(s) may be applied once, or repeatedly.

When the one or more alkaline earth metal salts and the one or more hydroxy-polycarboxylic acids are in the same post-color treatment composition, the weight ratio of the total amount of the one or more to the one or more hydroxy-polycarboxylic acids in the post-color treatment composition may be about 10:1 to about 1:10, about 5:1 to about 1:5, about 3:1 to about 1:3, or about 1:1. If the one or more alkaline earth metal salts and the one or more hydroxy-polycarboxylic acids are in separate post-color treatment compositions, the total amount of the one or more alkaline earth metal salts and the total amount of the one or more hydroxy-polycarboxylic acids may be applied to the hair in the ratios set forth above.

In some cases, the post-color treatment composition comprising the one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids is initially applied to the artificially colored hair within 24 hours of coloring the hair.

Likewise, the post-color treatment composition may be applied to the hair immediately after artificially coloring the hair, for example, within about 5 minutes, about 10 minutes, about 15 minutes, about 30 minutes, about 1 hour, or about 2 hours after artificially coloring the hair. After artificially coloring the hair, the hair may
5 optionally be dried prior to treatment with the post-color treatment composition(s) comprising the one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids.

The post-color treatment composition comprising the one or more alkaline earth metal salts and the one or more hydroxy-polycarboxylic acids can be applied
10 once, or may be applied multiple times. For example, it may be applied daily, weekly, monthly, or applied during the time of washing the hair. The post-color treatment compositions comprising the one or more alkaline earth metal salts and the one or more hydroxy-polycarboxylic acids may be a "stand-alone" product or may be formulated as another cosmetic product that is applied to the hair, thereby
15 creating a multi-purpose product. For example, the post-color treatment compositions comprising the one or more alkaline earth metal salts and the one or more hydroxy-polycarboxylic acids may be formulated as a pre or post shampooing treatment or "rinse" product, it may be formulated as a conditioner, which is typically applied to the hair immediately after shampooing. It may be formulated as an "over-
20 night" treatment to be applied to the hair and allowed to remain on the hair while the consumer sleeps.

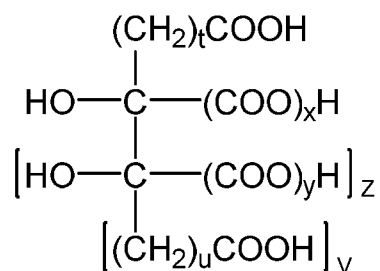
The post-color treatment compositions comprising the one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids are typically applied to the hair at room temperature and allowed to at least briefly remain on the hair.
25 For example, the post-color treatment compositions may be allowed to remain on the hair for at least about 1, about 2, about 5, about 10, about 15, about 20, about 25, or about 30 minutes after application. The post-color treatment composition may be allowed to remain on the hair for a long period of time (days), for example, until the following day when the hair is regularly shampooed. Alternatively, the post-color
30 treatment composition may remain on the hair for a short period of time. For example, the post-color treatment composition may be allowed to remain on the hair from about 1 minute to about 5, 10, 15, 20, or 30 minutes, or up to about 1 or 2 hours

before the hair is subsequently rinsed or shampooed. After the hair is rinsed or shampooed, it may optionally be dried prior to further treatments.

As mentioned above, the post-color treatment compositions comprising the one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids may be applied to the hair at room temperature (about 15°C to about 25°C). Further, the post-color treatment compositions may be applied at higher temperatures, for example, at temperatures from about 20°C to about 45°C, about 25°C to about 45°C, about 30°C to about 45°C. The post-color treatment compositions may be applied to the hair at one temperature, and then the hair containing the compositions may be warmed during treatment. Further, the post-color treatment compositions may be applied to the hair, and allowed to naturally dry on the hair, or a drying step may be included using heat and/or air (e.g., blow drying) to dry the composition onto the hair.

The instant disclosure further relates to methods for artificially coloring hair and inhibiting the coloring from fading from the artificially colored hair. In this scenario, the one or more alkaline earth metal salts is combined in the same composition that comprises the dye or hair coloring agents (in-color treatment composition), but the composition comprising the one or more hydroxy-polycarboxylic acids is applied subsequently as a post-color treatment in a separate composition. In this case, the methods typically involve:

- (a) treating hair with a coloring composition comprising one or more alkaline earth metal salts and coloring the hair;
- (b) subsequently treating the hair with a post-color treatment composition comprising one or more hydroxy-polycarboxylic acids of the formula



wherein, x and y are independently 0 or 1; and t, u, v, and z are independently 0 to 3.

In some cases, the one or more alkaline earth metal salts are selected from the group consisting of magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate. In other cases, the one or more alkaline earth metal salts include calcium chloride.

The one or more hydroxy-polycarboxylic acids may be selected from the group consisting of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and 2-hydroxy n-butyl 1,3,4-tricarboxylic acid. In some cases, the one or more hydroxy-polycarboxylic acids include citric acid.

The total amount of the one or more alkaline earth metal(s) in the coloring compositions may be from about 1 wt.% to about 50 wt.%, based on the total weight of the coloring composition. In some cases, the total amount of the one or more alkaline earth metal salts is from about 1 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, or about 45 wt.%. Likewise, in some cases the total amount of the one or more alkaline earth metal salts is from about 5 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%. Furthermore, in some cases the total amount of the one or more alkaline earth metal salts is from about 10 wt.% to about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%.

The coloring compositions of the present disclosure typically comprise at least one colorant compound chosen from oxidative dye precursors, direct dyes, pigments, and mixtures thereof. The oxidation dyes are generally chosen from one or more oxidation bases optionally combined with one or more couplers.

The coloring composition may include an oxidation agent. In many cases an oxidative agent is combined with the coloring compositions immediately prior to treating hair with the coloring treatment.

The total amount of the one or more hydroxy-polycarboxylic acids in the post-color treatment may be from about 1 wt.% to about 50 wt.%, based on the total

weight of the post-color treatment composition. In some cases, the total amount of the one or more hydroxy-polycarboxylic acids is from about 1 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, or about 45 wt.%. Likewise, in some cases the total amount of the one or more hydroxy-polycarboxylic acids is from about 5 wt.% to about 10 wt.%, about 15 wt.%, about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%. Furthermore, in some cases the total amount of the one or more hydroxy-polycarboxylic acids is from about 10 wt.% to about 20 wt.%, about 25 wt.%, about 30 wt.%, about 35 wt.%, about 40 wt.%, about 45 wt.%, or about 50 wt.%.

Typically, the post-color treatment composition is applied to the hair after the hair is colored, e.g., within 24 hours. Often, the post-color treatment composition is applied to the hair immediately after artificially coloring the hair, for example, within about 1 min., about 5 min., about 10 min., about 15 min., about 30 min., about 1 hour, or about 2 hours after artificially coloring the hair. The post-color treatment compositions described herein may be applied once, or may be applied multiple times. For example, the post-color treatment compositions may be applied daily, weekly, monthly, or applied during the time of washing the hair. The post-color treatment compositions may be "stand-alone" products or may be formulated as another cosmetic product that is applied to the hair, thereby creating a multi-purpose product. For example, the post-color treatment compositions may be formulated as a pre- or post- shampooing treatment or "rinse" product, it may be formulated as a conditioner, which is typically applied to the hair immediately after shampooing. It may be formulated as an "over-night" treatment to be applied to the hair and allowed to remain on the hair while the consumer sleeps.

The post-color treatment compositions may be applied to the hair at room temperature (about 15°C to about 25°C). Further, the post-color treatment compositions may be applied at higher temperatures, for example, at temperatures from about 20°C to about 45°C, about 25°C to about 45°C, about 30°C to about 45°C. The compositions may be applied to the hair at one temperature, and then the hair containing the compositions may be warmed during treatment. Further, post-color treatment composition may be applied to the hair, and allowed to naturally dry

on the hair, or a drying step may be included using heat and/or air (e.g., blow drying) to dry the composition onto the hair.

Finally, the instant disclosure relates to kits comprising the compositions described above, including the coloring compositions and/or the post-color treatment compositions. For example, the kit may include: (i) a coloring composition; and separately (ii) a composition comprising one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids. Likewise, the kit may include: (i) a coloring composition comprising one or more alkaline earth metal salts and a colorant; and separately, (ii) a composition comprising one or more hydroxy-polycarboxylic acids. Each of the kits may also optionally include an oxidizing agent or a composition comprising an oxidizing agent. Often, the kits described herein are accompanied by instructions for use, and may also optionally include utensils for mixing, applying, and maintaining the compositions. More exhaustive but non-limiting lists of components useful in the compositions disclosed herein are presented below.

Cosmetically Acceptable Solvent (or Carrier)

The compositions of the present disclosure may be presented in a cosmetically acceptable solvent. This cosmetically acceptable solvent may include, for example, water or a mixture of water and at least one cosmetically acceptable organic solvent.

As examples of organic solvents, non-limiting mentions can be made of monoalcohols and polyols such as ethyl alcohol, isopropyl alcohol, propyl alcohol, benzyl alcohol, and phenylethyl alcohol, or glycols or glycol ethers such as, for example, monomethyl, monoethyl and monobutyl ethers of ethylene glycol, propylene glycol or ethers thereof such as, for example, monomethyl ether of propylene glycol, butylene glycol, hexylene glycol, dipropylene glycol as well as alkyl ethers of diethylene glycol, for example monoethyl ether or monobutyl ether of diethylene glycol.

Other suitable examples of organic solvents are ethylene glycol, propylene glycol, butylene glycol, hexylene glycol, propane diol, and glycerin.

The organic solvents for use in the present disclosure can be volatile or non-volatile compounds.

The cosmetically acceptable solvent may be employed according to the present disclosure in an amount ranging from about 5% to about 95% by weight, or such as from about 20% to about 90% by weight, such as from about 30 to about 80% by weight, or such as from about 35% to about 75% by weight, such as from
 5 about 5 to about 50% by weight, such as from about 50 to 95% by weight, based on the total weight of the composition.

The organic solvent may be employed according to the present disclosure in an amount ranging from about 0.1% to about 25% by weight, such as from about 1% to about 15% by weight, or such as from about 3% to about 10% by weight, or such
 10 as from about 5% to about 10% by weight, based on the total weight of the composition of the present disclosure.

Colorants

The coloring compositions of the present disclosure include at least one colorant compound chosen from oxidative dye precursors, direct dyes, pigments,
 15 and mixtures thereof. The oxidation dyes are generally chosen from one or more oxidation bases optionally combined with one or more couplers. By way of example, the oxidation bases are chosen from para-phenylenediamines, bis(phenyl)alkylenediamines, para-aminophenols, ortho-aminophenols and heterocyclic bases, and the addition salts thereof.

Among the para-phenylenediamines that may be mentioned, for example, are
 20 para-phenylenediamine, para-toluenediamine, 2-chloro-para-phenylenediamine, 2,3-dimethyl-para-phenylenediamine, 2,6-dimethyl-para-phenylenediamine, 2,6-diethyl-para-phenylenediamine, 2,5-dimethyl-para-phenylenediamine, N,N-dimethyl-para-phenylenediamine, N,N-diethyl-para-phenylenediamine, N,N-dipropyl-para-
 25 phenylenediamine, 4-amino-N,N-diethyl-3-methylaniline, N,N-bis(.beta.-hydroxyethyl)-para-phenylenediamine, 4-N,N-bis(.beta.-hydroxyethyl)amino-2-methylaniline, 4-N,N-bis(.beta.-hydroxyethyl)amino-2-chloroaniline, 2-.beta.-hydroxyethyl-para-phenylenediamine, 2-methoxymethyl-para-phenylenediamine, 2-fluoro-para-phenylenediamine, 2-isopropyl-para-phenylenediamine, N-(.beta.-
 30 hydroxypropyl)-para-phenylenediamine, 2-hydroxymethyl-para-phenylenediamine, N,N-dimethyl-3-methyl-para-phenylenediamine, N-ethyl-N-(.beta.-hydroxyethyl)-para-phenylenediamine, N-(.beta.,.gamma.-dihydroxypropyl)-para-

phenylenediamine, N-(4'-aminophenyl)-para-phenylenediamine, N-phenyl-para-phenylenediamine, 2-.beta.-hydroxyethyloxy-para-phenylenediamine, 2-.beta.-acetylaminoethyloxy-para-phenylenediamine, N-(.beta.-methoxyethyl)-para-phenylenediamine, 4-aminophenylpyrrolidine, 2-thienyl-para-phenylenediamine, 2-
 5 .beta.-hydroxyethylamino-5-aminotoluene and 3-hydroxy-1-(4'-aminophenyl)pyrrolidine, and the addition salts thereof with an acid.

Among the para-phenylenediamines mentioned above, para-phenylenediamine, para-toluenediamine, 2-isopropyl-para-phenylenediamine, 2-.beta.-hydroxyethyl-para-phenylenediamine, 2-.beta.-hydroxyethyloxy-para-phenylenediamine, 2,6-dimethyl-para-phenylenediamine, 2,6-diethyl-para-phenylenediamine, 2,3-dimethyl-para-phenylenediamine, N,N-bis(.beta.-hydroxyethyl)-para-phenylenediamine, 2-chloro-para-phenylenediamine and 2-.beta.-acetylaminoethyloxy-para-phenylenediamine, and the addition salts thereof with an acid, are particularly preferred.

Among the bis(phenyl)alkylenediamines that may be mentioned, for example, are N,N'-bis(.beta.-hydroxyethyl)-N,N'-bis(4'-aminophenyl)-1,3-diaminopropano-1, N,N'-bis(.beta.-hydroxyethyl)-N,N'-bis(4'-aminophenyl)ethylenediamine, N,N'-bis(4-aminophenyl)tetramethylenediamine, N,N'-bis(.beta.-hydroxyethyl)-N,N'-bis(4-aminophenyl)tetramethylenediamine, N,N'-bis(4-aminophenyl)tetramethylenediamine, N,N'-bis(ethyl)-N,N'-bis(4'-amino-3'-methylphenyl)ethylenediamine and 1,8-bis(2,5-diaminophenoxy)-3,6-dioxaoctane, and the addition salts thereof.

Among the para-aminophenols that may be mentioned, for example, are para-aminophenol, 4-amino-3-methylphenol, 4-amino-3-fluorophenol, 4-amino-3-chlorophenol, 4-amino-3-hydroxymethylphenol, 4-amino-2-methylphenol, 4-amino-2-hydroxymethylphenol, 4-amino-2-methoxymethylphenol, 4-amino-2-aminomethylphenol, 4-amino-2-(.beta.-hydroxyethylaminomethyl)phenol and 4-amino-2-fluorophenol, and the addition salts thereof with an acid.

Among the ortho-aminophenols that may be mentioned, for example, are 2-aminophenol, 2-amino-5-methylphenol, 2-amino-6-methylphenol and 5-acetamido-2-aminophenol, and the addition salts thereof.

Among the heterocyclic bases that may be mentioned, for example, are pyridine derivatives, pyrimidine derivatives and pyrazole derivatives.

Among the pyridine derivatives that may be mentioned are the compounds such as 2,5-diaminopyridine, 2-(4-methoxyphenyl)amino-3-aminopyridine and 3,4-diaminopyridine, and the addition salts thereof. Other pyridine oxidation bases that are useful in the present disclosure are the 3-aminopyrazolo[1,5-a]pyridine oxidation bases or the addition salts thereof described, for example, in patent application FR 2 801 308. Examples that may be mentioned include pyrazolo[1,5-a]pyrid-3-ylamine, 2-acetylaminopyrazolo[1,5-a]pyrid-3-ylamine, 2-morpholin-4-ylpyrazolo[1,5-a]pyrid-3-ylamine, 3-aminopyrazolo[1,5-a]pyridine-2-carboxylic acid, 2-methoxypyrazolo[1,5-a]pyrid-3-ylamine, (3-aminopyrazolo[1,5-a]pyrid-7-yl)methanol, 2-(3-aminopyrazolo[1,5-a]pyrid-5-yl)ethanol, 2-(3-aminopyrazolo[1,5-a]pyrid-7-yl)ethanol, (3-aminopyrazolo[1,5-a]pyrid-2-yl)methanol, 3,6-diaminopyrazolo[1,5-a]pyridine, 3,4-diaminopyrazolo[1,5-a]pyridine, pyrazolo[1,5-a]pyridine-3,7-diamine, 7-morpholin-4-ylpyrazolo[1,5-a]pyrid-3-ylamine, pyrazolo[1,5-a]pyridine-3,5-diamine, 5-morpholin-4-ylpyrazolo[1,5-a]pyrid-3-ylamine, 2-[(3-aminopyrazolo[1,5-a]pyrid-5-yl)(2-hydroxyethyl)amino]ethanol, 2-[(3-aminopyrazolo[1,5-a]pyrid-7-yl)(2-hydroxyethyl)amino]ethanol, 3-aminopyrazolo[1,5-a]pyridin-5-ol, 3-aminopyrazolo[1,5-a]pyridin-4-ol, 3-aminopyrazolo[1,5-a]pyridin-6-ol, 3-aminopyrazolo[1,5-a]pyridin-7-ol, 2-.quadrature.-hydroxyethoxy-3-amino-pyrazolo[1,5-a]pyridine; 2-(4-dimethylpyperazinium-1-yl)-3-amino-pyrazolo[1,5-a]pyridine; and the addition salts thereof.

More particularly oxidation bases that are useful in the present disclosure are selected from 3-aminopyrazolo-[1,5-a]-pyridines and preferably substituted on carbon atom 2 by:

- (a) one (di)(C₁-C₆)(alkyl)amino group wherein said alkyl group can be substituted by at least one hydroxy, amino, imidazolium group;
- (b) one heterocycloalkyl group containing from 5 to 7 members chain, and from 1 to 3 heteroatoms, potentially cationic, potentially substituted by one or more (C₁-C₆-alkyl, such as di(C₁-C₄)alkylpiperazinium; or
- (c) one (C₁-C₆)alkoxy potentially substituted by one or more hydroxy groups such as .quadrature.-hydroxyalkoxy, and the addition salts thereof.

Among the pyrimidine derivatives that may be mentioned are compounds such as 2,4,5,6-tetraaminopyrimidine, 4-hydroxy-2,5,6-triaminopyrimidine, 2-hydroxy-4,5,6-triaminopyrimidine, 2,4-dihydroxy-5,6-diaminopyrimidine, 2,5,6-triaminopyrimidine and their addition salts and their tautomeric forms, when a
5 tautomeric equilibrium exists.

Among the pyrazole derivatives that may be mentioned are compounds such as 4,5-diamino-1-methyl-pyrazole, 4,5-diamino-1-(.beta.-hydroxyethyl)pyrazole, 3,4-diamino-pyrazole, 4,5-diamino-1-(4'-chlorobenzyl)pyrazole, 4,5-diamino-1,3-dimethylpyrazole, 4,5-diamino-3-methyl-1-phenyl-pyrazole, 4,5-diamino-1-methyl-3-phenylpyrazole, 4-amino-1,3-dimethyl-5-hydrazinopyrazole, 1-benzyl-4,5-diamino-3-methyl-pyrazole, 4,5-diamino-3-tert-butyl-1-methylpyrazole, 4,5-diamino-1-tert-butyl-3-methylpyrazole, 4,5-diamino-1-(.beta.-hydroxyethyl)-3-methylpyrazole, 4,5-diamino-1-ethyl-3-methyl-pyrazole, 4,5-diamino-1-ethyl-3-(4'-methoxyphenyl)pyrazole, 4,5-diamino-1-ethyl-3-hydroxymethylpyrazole, 4,5-diamino-3-hydroxymethyl-1-methylpyrazole, 4,5-diamino-3-hydroxymethyl-1-isopropylpyrazole, 4,5-diamino-3-methyl-1-isopropylpyrazole, 4-amino-5-(2'-aminoethyl)amino-1,3-dimethylpyrazole, 3,4,5-triaminopyrazole, 1-methyl-3,4,5-triaminopyrazole, 3,5-diamino-1-methyl-4-methylaminopyrazole, 3,5-diamino-4-(.beta.-hydroxyethyl)amino-1-methylpyrazole, and the addition salts thereof. 4,5-Diamino-1-(.beta.-methoxyethyl)pyrazole may also be used.
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Pyrazole derivatives that may also be mentioned include diamino-N,N-dihydropyrazolopyrazolones such as the following compounds and the addition salts thereof: 2,3-diamino-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one, 2-amino-3-ethylamino-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one, 2-amino-3-isopropylamino-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one, 2-amino-3-(pyrrolidin-1-yl)-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one, 4,5-diamino-1,2-dimethyl-1,2-dihydropyrazol-3-one, 4,5-diamino-1,2-diethyl-1,2-dihydropyrazol-3-one, 4,5-diamino-1,2-di-(2-hydroxyethyl)-1,2-dihydropyrazol-3-one, 2-amino-3-(2-hydroxyethyl)amino-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one, 2-amino-3-dimethylamino-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one, 2,3-diamino-5,6,7,8-tetrahydro-1H,6H-pyridazino[1,2-a]pyrazol-1-one, 4-amino-1,2-diethyl-5-(pyrrolidin-1-yl)-1,2-dihydropyrazol-3-one, 4-amino-5-(3-dimethylaminopyrrolidin-1-yl)-1,2-diethyl-1,2-dihydropyrazol-3-one, 2,3-diamino-6-hydroxy-6,7-dihydro-1H,5H-
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pyrazolo[1,2-a]pyrazol-1-one. 2,3-Diamino-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one and/or a salt thereof will preferably be used. 4,5-Diamino-1-(.beta.-hydroxyethyl)pyrazole and/or 2,3-diamino-6,7-dihydro-1H,5H-pyrazolo[1,2-a]pyrazol-1-one and/or a salt thereof will preferentially be used as heterocyclic bases.

5 Composition according to the present disclosure may optionally comprise one or more couplers advantageously chosen from those conventionally used in the dyeing or coloring of keratin fibers.

Among these couplers, mention may be made especially of meta-phenylenediamines, meta-aminophenols, meta-diphenols, naphthalene-based
10 couplers and heterocyclic couplers, and also the addition salts thereof.

Mention may be made, for example, of 2-methyl-5-aminophenol, 5-N-(.beta.-hydroxyethyl)amino-2-methylphenol, 3-aminophenol, 5-amino-6-chloro-o-cresol (3-amino-2-chloro-6-methylphenol), 1,3-dihydroxybenzene, 1,3-dihydroxy-2-methylbenzene, 4-chloro-1,3-dihydroxybenzene, 2,4-diamino-1-(.beta.-hydroxyethoxy)benzene, 2-amino-4-(.beta.-hydroxyethylamino)-1-methoxybenzene, 1,3-diaminobenzene, 1,3-bis(2,4-diamino-phenoxy)propane, 3-ureidoaniline, 3-ureido-1-dimethylamino-benzene, sesamol, 1-.beta.-hydroxyethylamino-3,4-methylene-dioxybenzene, .alpha.-naphthol, 2-methyl-1-naphthol, 6-hydroxyindole, 4-hydroxyindole, 4-hydroxy-N-methylindole, 2-amino-3-hydroxypyridine, 6-hydroxybenzomorpholine, 3,5-diamino-2,6-dimethoxypyridine, 1-N-(.beta.-hydroxyethyl)amino-3,4-methylene-dioxybenzene, 2,6-bis(J-hydroxyethylamino)toluene, 6-hydroxy-indoline, 2,6-dihydroxy-4-methylpyridine, 1-H-3-methylpyrazol-5-one, 1-phenyl-3-methylpyrazol-5-one, 2,6-dimethyl-pyrazolo[1,5-b]-1,2,4-triazole, 2,6-dimethyl[3,2-c]-1,2,4-triazole and 6-methylpyrazolo[1,5-a]benzimidazole, the addition salts thereof with an acid, and mixtures thereof.
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In general, the addition salts of the oxidation bases and couplers that may be used in the context of the disclosure are especially selected from the addition salts with an acid such as the hydrochlorides, hydrobromides, sulfates, citrates, succinates, tartrates, lactates, tosylates, benzenesulfonates, phosphates and
30 acetates.

The oxidation base(s) each advantageously represent from 0.001% to 10% by weight relative to the total weight of the composition, and preferably from 0.005% to

5% by weight relative to the total weight of the compositions of the present disclosure.

The coupler(s), if they are present, each advantageously represent from 0.001% to 10% by weight relative to the total weight of the composition, and preferably from 0.005% to 5% by weight relative to the total weight of the compositions of the present disclosure.

Compositions according to the disclosure may optionally comprise b) one or more synthetic or natural direct dyes, chosen from anionic and nonionic species, preferably cationic or nonionic species, either as sole dyes or in addition to the oxidation dye(s).

Examples of suitable direct dyes that may be mentioned include azo direct dyes; (poly)methine dyes such as cyanins, hemicyanins and styryls; carbonyl dyes; azine dyes; nitro(hetero)aryl dyes; tri(hetero)arylmethane dyes; porphyrin dyes; phthalocyanin dyes, and natural direct dyes, alone or as mixtures.

Many direct dyes are cationic direct dyes. Mention may be made of the hydrazono cationic dyes of formulas (Va) and (V'a), the azo cationic dyes (VIa) and (VI'a) and the diazo cationic dyes (VIIa) below:

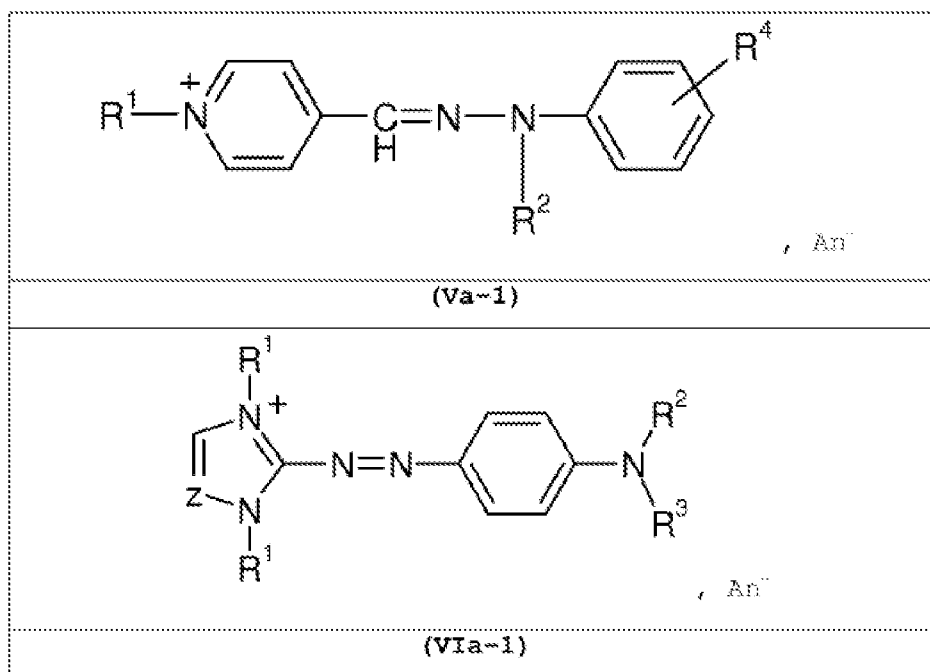
$\text{Het}^+ - \text{C}(\text{R}^a) = \text{N} - \text{N}(\text{R}^b) - \text{Ar}, \text{An}^-$	(Va)
$\text{Het}^+ - \text{N}(\text{R}^a) - \text{N} = \text{C}(\text{R}^b) - \text{Ar}, \text{An}^-$	(V'a)
$\text{Het}^+ - \text{N} = \text{N} - \text{Ar}, \text{An}^-$	(VIa)
$\text{Ar}^+ - \text{N} = \text{N} - \text{Ar}', \text{An}^-$	(VI'a) and
$\text{Het}^+ - \text{N} = \text{N} - \text{Ar}' - \text{N} = \text{N} - \text{Ar}, \text{An}^-$	(VIIa)

in which formulas (Va), (V'a), (VIa), (VI'a) and (VIIa):

- Het^+ represents a cationic heteroaryl radical, preferably bearing an endocyclic cationic charge, such as imidazolium, indolium or pyridinium, optionally substituted preferentially with one or more ($\text{C}_1\text{-C}_8$) alkyl groups such as methyl;

- Ar^+ representing an aryl radical, such as phenyl or naphthyl, bearing an exocyclic cationic charge, preferentially ammonium, particularly tri(C_1-C_8)alkylammonium such as trimethylammonium;
- Ar represents an aryl group, especially phenyl, which is optionally substituted, preferentially with one or more electron-donating groups such as i) optionally substituted (C_1-C_8)alkyl, ii) optionally substituted (C_1-C_8)alkoxy, iii) (di)(C_1-C_8)(alkyl)amino optionally substituted on the alkyl group(s) with a hydroxyl group, iv) aryl(C_1-C_8)alkylamino, v) optionally substituted N--(C_1-C_8)alkyl-N-aryl(C_1-C_8)alkylamino or alternatively Ar represents a julolidine group;
- Ar' is an optionally substituted divalent (hetero)arylene group such as phenylene, particularly para-phenylene, or naphthalene, which are optionally substituted, preferentially with one or more groups (C_1-C_8)alkyl, hydroxyl or (C_1-C_8)alkoxy
- Ar'' is an optionally substituted (hetero)aryl group such as phenyl or pyrazolyl, which are optionally substituted, preferentially with one or more groups (C_1-C_8)alkyl, hydroxyl, (di)(C_1-C_8)(alkyl)amino, (C_1-C_8)alkoxy or phenyl;
- R^a and R^b , which may be identical or different, represent a hydrogen atom or a group (C_1-C_8)alkyl, which is optionally substituted, preferentially with a hydroxyl group;
- or alternatively the substituent R^a with a substituent of Het^+ and/or R_b with a substituent of Ar and/or R^a with R_b form, together with the atoms that bear them, a (hetero)cycloalkyl;
- particularly, R^a and R_b represent a hydrogen atom or a group (C_1-C_4)alkyl, which is optionally substituted with a hydroxyl group;
- An^- represents an anionic counter-ion such as mesylate or halide. In particular, mention may be made of the azo and hydrazono cationic dyes bearing an endocyclic cationic charge of formulae (Va), (V'a) and (VIa) as defined previously. More particularly those of formulae (Va), (V'a) and (VIa) derived from the dyes described in patent applications WO 95/15144, WO 95/01772 and EP-714954, which are incorporated herein by reference in their entirety.

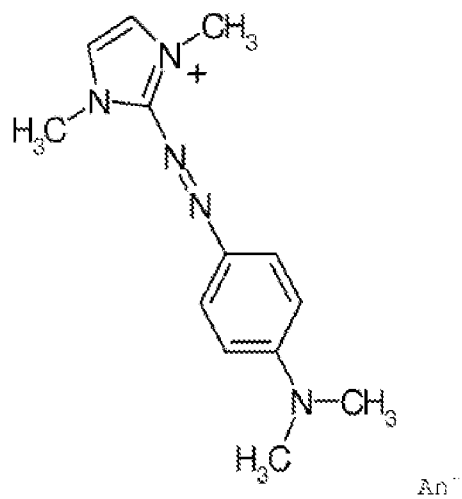
In some cases, the cationic part is derived from the following derivatives:



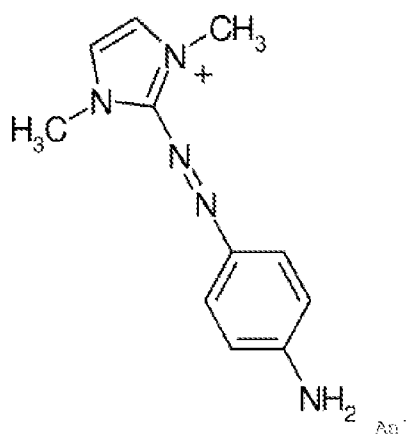
formulae (V-1) and (VI-1) with:

- R^1 representing a ($\text{C}_1\text{-C}_4$) alkyl group such as methyl;
- 5 - R^2 and R^3 , which are identical or different, represent a hydrogen atom or a ($\text{C}_1\text{-C}_4$)alkyl group, such as methyl; and
- R^4 represents a hydrogen atom or an electron-donating group such as optionally substituted ($\text{C}_1\text{-C}_8$)alkyl, optionally substituted ($\text{C}_1\text{-C}_8$)alkoxy, or (di)($\text{C}_1\text{-C}_8$)(alkyl)amino optionally substituted on the alkyl group(s) with a hydroxyl group;
- 10 particularly, R^4 is a hydrogen atom,
- Z represents a CH group or a nitrogen atom, preferentially CH;
- An^- represents an anionic counter-ion such as mesylate or halide.

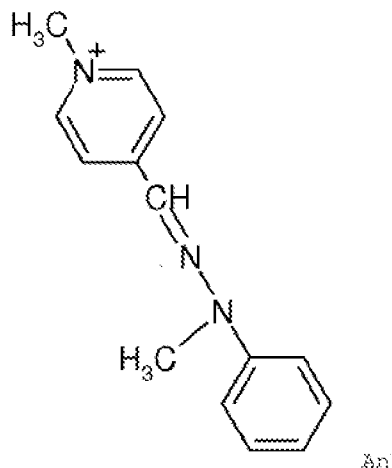
Particularly, the dye of formulae (Va-1) and (VIa-1) is chosen from Basic Red 51, Basic Yellow 87 and Basic Orange 31 or derivatives thereof:



Basic Red 51



Basic Orange 31



Basic Yellow 87

Among the natural direct dyes that may be used according to the disclosure,
 5 mention may be made of lawsone, juglone, alizarin, purpurin, carminic acid, kermesic acid, purpurogallin, protocatechaldehyde, indigo, isatin, curcumin, spinulosin, apigenidin and orceins. Extracts or decoctions containing these natural dyes and in particular henna-based poultices or extracts may also be used.

When they are present, the direct dye(s) more particularly represent from
 10 0.001% to 10% by weight and preferably from 0.005% to 5% by weight of the total weight of the compositions of the present disclosure.

Surfactants

The various compositions described herein may include one or more
 surfactants, including cationic, anionic, non-ionic and/or amphoteric/zwitterionic
 15 surfactants. Non-limiting examples of surfactants that may be used are provided below.

Cationic Surfactants

The term "cationic surfactant" means a surfactant that is positively charged
 when it is contained in the composition according to the disclosure. This surfactant
 20 may bear one or more positive permanent charges or may contain one or more functions that are cationizable in the composition according to the disclosure.

Non-limiting examples of cationic surfactants include behenalkonium chloride, benzethonium chloride, cetylpyridinium chloride, behentrimonium chloride, lauralkonium chloride, cetalkonium chloride, cetrimonium bromide, cetrimonium chloride, cethylamine hydrofluoride, chlorallylmethenamine chloride (Quaternium-5), distearyldimonium chloride (Quaternium-5), dodecyl dimethyl ethylbenzyl ammonium chloride(Quaternium-14), Quaternium-22, Quaternium-26, Quaternium-18 hectorite, dimethylaminoethylchloride hydrochloride, cysteine hydrochloride, diethanolammonium POE (10) oleyl ether phosphate, diethanolammonium POE (3)oleyl ether phosphate, tallow alkonium chloride, dimethyl

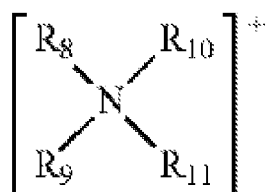
diocetadecylammoniumbentonite, stearalkonium chloride, domiphen bromide, denatonium benzoate, myristalkonium chloride, laurtrimonium chloride, ethylenediamine dihydrochloride, guanidine hydrochloride, pyridoxine HCl, iofetamine hydrochloride, meglumine hydrochloride, methylbenzethonium chloride, myrtrimonium bromide, oleyltrimonium chloride, polyquaternium-1,

procainehydrochloride, cocobetaine, stearalkonium bentonite, stearalkoniumhectonite, stearyl trihydroxyethyl propylenediamine dihydrofluoride, tallowtrimonium chloride, and hexadecyltrimethyl ammonium bromide.

The cationic surfactant(s) may be chosen from optionally polyoxyalkylenated, primary, secondary or tertiary fatty amines, or salts thereof, and quaternary ammonium salts, and mixtures thereof.

The fatty amines generally comprise at least one C₈-C₃₀ hydrocarbon-based chain.

Examples of quaternary ammonium salts that may especially be mentioned include: those corresponding to the general formula (III) below:



(III)

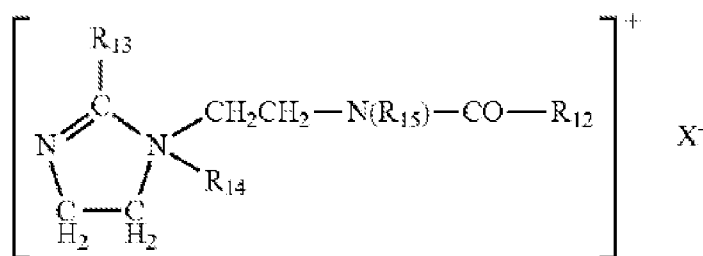
in which the groups R₈ to R₁₁, which may be identical or different, represent a linear or branched, saturated or unsaturated aliphatic group comprising from 1 to 30

carbon atoms, or an aromatic group such as aryl or alkylaryl, at least one of the groups R_8 to R_{11} denoting a group comprising from 8 to 30 carbon atoms and preferably from 12 to 24 carbon atoms. The aliphatic groups may comprise heteroatoms especially such as oxygen, nitrogen, sulfur and halogens. The aliphatic groups are chosen, for example, from C_1 - C_{30} alkyl, C_2 - C_{30} alkenyl, C_1 - C_{30} alkoxy, polyoxy(C_2 - C_6)alkylene, C_1 - C_{30} alkylamide, (C_{12} - C_{22})alkylamido(C_2 - C_6)alkyl, (C_{12} - C_{22})alkyl acetate and C_1 - C_{30} hydroxyalkyl groups; X^- is an anion chosen from the group of halides, phosphates, acetates, lactates, (C_1 - C_4)alkyl sulfates, and (C_1 - C_4)alkyl- or (C_1 - C_4)alkylarylsulfonates.

Among the quaternary ammonium salts of formula (III), those that are preferred are, on the one hand, tetraalkylammonium salts, for instance dialkyldimethylammonium or alkyltrimethylammonium salts in which the alkyl group contains approximately from 12 to 22 carbon atoms, in particular behenyltrimethylammonium, distearyldimethylammonium, cetyltrimethylammonium or benzyldimethylstearyl ammonium salts, or, on the other hand, oleocetyldimethylhydroxyethylammonium salts, palmitylamidopropyltrimethylammonium salts, stearamidopropyltrimethylammonium salts and stearamidopropyldimethylcetearyl ammonium salts.

In some cases it is useful to use salts such as the chloride salts of the following compounds:

A. a quaternary ammonium salt of imidazoline, such as, for example, those of formula (IV) below:

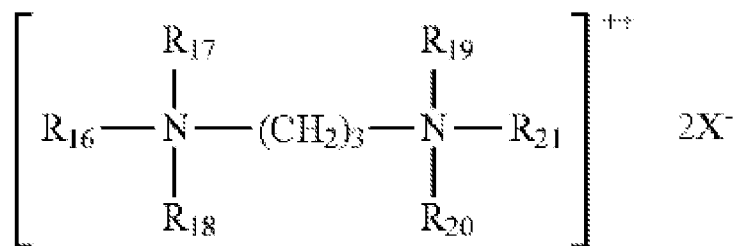


(IV)

in which R_{12} represents an alkenyl or alkyl group comprising from 8 to 30 carbon atoms, derived for example from tallow fatty acids, R_{13} represents a hydrogen atom, a C_1 - C_4 alkyl group or an alkyl or alkenyl group comprising from 8 to 30 carbon

atoms, R_{14} represents a C_1 - C_4 alkyl group, R_{15} represents a hydrogen atom or a C_1 - C_4 alkyl group, X^- is an anion chosen from the group of halides, phosphates, acetates, lactates, alkyl sulfates, alkyl- or alkylaryl-sulfonates in which the alkyl and aryl groups preferably comprise, respectively, from 1 to 20 carbon atoms and from 6 to 30 carbon atoms. R_{12} and R_{13} preferably denote a mixture of alkenyl or alkyl groups containing from 12 to 21 carbon atoms, derived for example from tallow fatty acids, R_{14} preferably denotes a methyl group, and R_{15} preferably denotes a hydrogen atom. Such a product is sold, for example, under the name Rewoquat(R) W 75 by the company Rewo;

- 10 B. a quaternary diammonium or triammonium salt, in particular of formula (V):

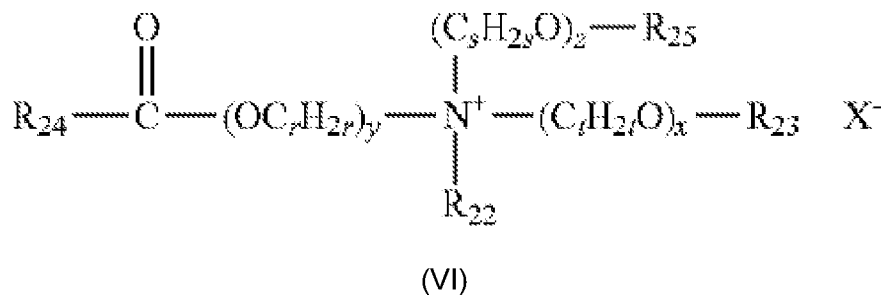


(V)

- 15 in which R_{16} denotes an alkyl radical comprising approximately from 16 to 30 carbon atoms, which is optionally hydroxylated and/or interrupted with one or more oxygen atoms, R_{17} is chosen from hydrogen or an alkyl radical comprising from 1 to 4 carbon atoms or a group $(R_{16a})(R_{17a})(R_{18a})N-(CH_2)_3$,

- 20 R_{16a} , R_{17a} , R_{18a} , R_{18} , R_{19} , R_{20} and R_{21} , which may be identical or different, being chosen from hydrogen and an alkyl radical comprising from 1 to 4 carbon atoms, and X^- is an anion chosen from the group of halides, acetates, phosphates, nitrates and methyl sulfates. Such compounds are, for example, Finquat CT-P, sold by the company Finetex (Quaternium 89), and Finquat CT, sold by the company Finetex (Quaternium 75),

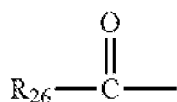
- 25 C. a quaternary ammonium salt containing at least one ester function, such as those of formula (VI) below:



in which:

R₂₂ is chosen from C₁-C₆ alkyl groups and C₁-C₆ hydroxyalkyl or
 5 dihydroxyalkyl groups;

R₂₃ is chosen from:



R₂₇, which is a linear or branched, saturated or unsaturated
 C₁-C₂₂ hydrocarbon-based group, and a hydrogen atom,

R₂₅ is chosen from:

10 $\begin{array}{c} \text{O} \\ \parallel \\ \text{R}_{28}-\text{C}- \end{array}$, R₂₉, which is a linear or branched, saturated or unsaturated C₁-
 C₆ hydrocarbon-based group, and a hydrogen atom,

R₂₄, R₂₆ and R₂₈, which may be identical or different, are chosen from linear or
 branched, saturated or unsaturated C₇-C₂₁ hydrocarbon-based groups;

r, s and t, which may be identical or different, are integers ranging from 2 to 6;

15 y is an integer ranging from 1 to 10;

x and z, which may be identical or different, are integers ranging from 0 to 10;

X⁻ is a simple or complex, organic or mineral anion;

with the proviso that the sum x+y+z is from 1 to 15, that when x is 0 then R_n
 denotes R₂₇, and that when z is 0 then R₂₅ denotes R₂₉.

20 The alkyl groups R₂₂ may be linear or branched, and more particularly linear.
 In some cases, R₂₂ denotes a methyl, ethyl, hydroxyethyl or dihydroxypropyl group,

and more particularly a methyl or ethyl group. Advantageously, the sum $x+y+z$ is from 1 to 10.

When R_{23} is a hydrocarbon-based group R_{27} , it may be long and contain from 12 to 22 carbon atoms, or may be short and contain from 1 to 3 carbon atoms.

5 When R_{25} is an R_{29} hydrocarbon-based group, it preferably contains 1 to 3 carbon atoms. Advantageously, R_{24} , R_{26} and R_{28} , which may be identical or different, are chosen from linear or branched, saturated or unsaturated C_{11} - C_{21} hydrocarbon-based groups, and more particularly from linear or branched, saturated or unsaturated C_{11} - C_{21} alkyl and alkenyl groups.

10 In some cases, x and z , which may be identical or different, have values of 0 or 1. Likewise, in some cases y is equal to 1. In some cases, r , s and t , which may be identical or different, are equal to 2 or 3, and even more particularly are equal to 2.

The anion X^- may be a halide (chloride, bromide or iodide) or an alkyl sulfate, more particularly methyl sulfate. However, use may be made of methanesulfonate, phosphate, nitrate, tosylate, an anion derived from an organic acid, such as acetate or lactate, or any other anion compatible with the ammonium containing an ester function.

The anion X^- is even more particularly chloride or methyl sulfate.

20 Use is made more particularly, in the composition according to the invention, of the ammonium salts of formula (VI) in which:

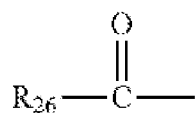
R_{22} denotes a methyl or ethyl group,

x and y are equal to 1;

z is equal to 0 or 1;

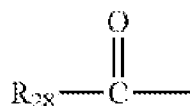
25 r , s and t are equal to 2;

R_{23} is chosen from:



, methyl, ethyl or C_{14} - C_{22} hydrocarbon-based groups, and a hydrogen atom;

R₂₅ is chosen from:



and a hydrogen atom;

R₂₄, R₂₆ and R₂₈, which may be identical or different, are chosen from linear or branched, saturated or unsaturated C₁₃-C₁₇ hydrocarbon-based groups, and preferably from linear or branched, saturated or unsaturated C₁₃-C₁₇ alkyl and alkenyl groups. The hydrocarbon-based groups are advantageously linear.

Mention may be made, for example, of the compounds of formula (VI) such as the diacyloxyethyl dimethylammonium, diacyloxyethyl hydroxyethyl methylammonium, monoacyloxyethyl dihydroxyethyl methylammonium, triacyloxyethyl methylammonium and monoacyloxyethyl hydroxyethyl dimethylammonium salts (chloride or methyl sulfate in particular), and mixtures thereof. The acyl groups preferably contain 14 to 18 carbon atoms and are obtained more particularly from a plant oil, such as palm oil or sunflower oil. When the compound contains several acyl groups, these groups may be identical or different.

These products are obtained, for example, by direct esterification of triethanolamine, triisopropanolamine, an alkyldiethanolamine or an alkyldiisopropanolamine, which are optionally oxyalkylenated, with C₁₀-C₃₀ fatty acids or with mixtures of C₁₀-C₃₀ fatty acids of plant or animal origin, or by transesterification of the methyl esters thereof. This esterification is followed by quaternization using an alkylating agent such as an alkyl (preferably methyl or ethyl) halide, a dialkyl (preferably methyl or ethyl) sulfate, methyl methanesulfonate, methyl para-toluenesulfonate, glycol chlorohydrin or glycerol chlorohydrin. Such compounds are, for example, sold under the names Dehyquart(R) by the company Henkel, Stepanquat(R) by the company Stepan, Noxamium(R) by the company Ceca or Rewoquat(R) WE 18 by the company Rewo-Witco.

The composition according to the invention may contain, for example, a mixture of quaternary ammonium monoester, diester and triester salts with a weight majority of diester salts.

Use may be made of behenoylhydroxypropyltrimethylammonium chloride, provided by Kao under the name Quatarmin BTC 131.

Nonionic Surfactants

Examples of nonionic surfactants that may be used are described, for example, in the Handbook of Surfactants by M. R. Porter, published by Blackie & Son (Glasgow and London), 1991, pp. 116-178, which is incorporated herein by reference in its entirety. The nonionic surfactant may be alcohols, alpha-diols and (C₁-C₂₄)alkylphenols, these compounds being polyethoxylated, polypropoxylated and/or polyglycerolated, and containing at least one fatty chain comprising, for example, from 8 to 18 carbon atoms, it being possible for the number of ethylene oxide and/or propylene oxide groups to especially range from 2 to 50, and for the number of glycerol groups to especially range from 2 to 30.

Mention may also be made of copolymers of ethylene oxide and propylene oxide, optionally oxyethylenated sorbitan fatty acid esters, sucrose fatty acid esters, polyoxyalkylenated fatty acid esters, polyoxyalkylenated fatty amides, optionally oxyalkylenated alkyl(poly)glucosides, alkylglucoside esters, derivatives of N-alkylglucamine and of N-acylmethylglucamine, aldobionamides, amine oxides and (poly)oxyalkylenated silicones.

The nonionic surfactants are more particularly chosen from monooxyalkylenated or polyoxyalkylenated and monoglycerolated or polyglycerolated nonionic surfactants, and alkyl(poly)glucosides. The oxyalkylene units are more particularly oxyethylene or oxypropylene units, or a combination thereof, preferably oxyethylene units.

Useful nonionic surfactants may include : oxyalkylenated (C₈-C₂₄)alkylphenols; saturated or unsaturated, linear or branched, oxyalkylenated C₈-C₄₀ alcohols; saturated or unsaturated, linear or branched, oxyalkylenated C₈-C₃₀ amides; esters of saturated or unsaturated, linear or branched, C₈-C₃₀ acids and of polyethylene glycols; saturated or unsaturated, oxyethylenated plant oils; condensates of ethylene oxide and/or of propylene oxide, alone or as mixtures; oxyethylenated and/or oxypropylenated silicones; and alkyl(poly)glucosides.

As examples of monoglycerolated or polyglycerolated nonionic surfactants, monoglycerolated or polyglycerolated C₈-C₄₀ alcohols are useable. In particular, the

monoglycerolated or polyglycerolated C₈-C₄₀ alcohols correspond to formula (VIII) below:



5 (VIII)

in which formula (VIII):

R₂₉ represents a linear or branched C₈-C₄₀ and preferably C₈-C₃₀ alkyl or alkenyl radical; and

10 m represents a number ranging from 1 to 30, or from 1 to 10.

As examples of compounds of formula (VIII), mention may be made of lauryl alcohol containing 4 mol of glycerol (INCI name: Polyglyceryl-4 Lauryl Ether), lauryl alcohol containing 1.5 mol of glycerol, oleyl alcohol containing 4 mol of glycerol (INCI name: Polyglyceryl-4 Oleyl Ether), oleyl alcohol containing 2 mol of glycerol (INCI name: Polyglyceryl-2 Oleyl Ether), cetearyl alcohol containing 2 mol of glycerol, cetearyl alcohol containing 6 mol of glycerol, oleocetyl alcohol containing 6 mol of glycerol, and octadecanol containing 6 mol of glycerol.

The alcohol of formula (VIII) may represent a mixture of alcohols in the same way that the value of m represents a statistical value, which means that, in a commercial product, several species of polyglycerolated fatty alcohols may coexist in the form of a mixture.

The alkyl(poly)glycoside nonionic surfactant(s) may be represented by formula (IX) below:



25 (IX)

in which:

R₃₀ represents a saturated or unsaturated, linear or branched alkyl group comprising from about 8 to 24 carbon atoms, or an alkylphenyl group in which the linear or branched alkyl group comprises from 8 to 24 carbon atoms;

R_{31} represents an alkylene group containing from about 2 to 4 carbon atoms,

G represents a saccharide unit comprising from 5 to 6 carbon atoms,

t denotes a value ranging from 0 to 10, or from 0 to 4, and

v denotes a value ranging from 1 to 15.

5 In some cases, the alkyl(poly)glycoside nonionic surfactant(s) correspond to formula (IX) in which:

R_{30} denotes a linear or branched, saturated or unsaturated alkyl group containing from 8 to 18 carbon atoms,

G denotes glucose, fructose or galactose, preferably glucose,

10 t denotes a value ranging from 0 to 3, and is preferably equal to 0, and

R_{31} and v are as defined previously.

The degree of polymerization of the alkyl(poly)glucoside nonionic surfactant(s), as represented, for example, by the index v in formula (IX), ranges on average from 1 to 15, or from 1 to 4. This degree of polymerization more particularly
15 ranges from 1 to 2 and better still from 1.1 to 1.5, on average.

The glycoside bonds between the saccharide units are of 1.6 or 1.4 type and preferably of 1.4 type.

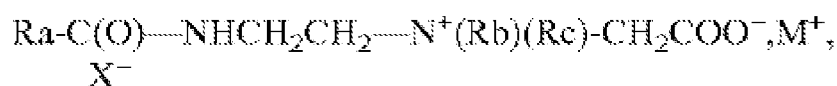
Examples of compounds of formula (IX) that may especially be mentioned are the products sold by the company Cognis under the names Plantaren.RTM. (600
20 CS/U, 1200 and 2000) or Plantacare.RTM. (818, 1200 and 2000). Use may also be made of the products sold by the company SEPPIC under the names Triton CG 110 (or Oramix CG 110) and Triton CG 312 (or Oramix.RTM. NS 10), the products sold by the company BASF under the name Lutensol GD 70 or the products sold by the company Chem Y under the name AG10 LK. Use may also be made, for example, of
25 the 1,4-(C_8 - C_{16})alkylpolyglucoside as an aqueous solution at 53% by weight relative to the total weight of the solution, sold by Cognis under the reference Plantacare 818 UP.

Amphoteric or Zwitterionic Surfactants

The amphoteric or zwitterionic surfactant that may be used in compositions
30 according to the disclosure may be derivatives of aliphatic secondary or tertiary

amines, optionally quaternized, in which derivatives the aliphatic group is a linear or branched chain comprising from 8 to 22 carbon atoms, the amine derivatives containing at least one anionic group, such as a carboxylate, sulfonate, sulfate, phosphate or phosphonate group. Mention may be made in particular of (C₈-C₂₀)alkylbetaines such as cocoylbetaine, sulfobetaines, (C₈-C₂₀)alkylamido(C₂-C₈)alkylbetaines such as cocoylamidopropylbetaine or (C₈-C₂₀)alkylamido(C₆-C₈)alkylsulfobetaines, and mixtures thereof.

Among the derivatives of aliphatic secondary or tertiary amines, optionally quaternized, that may be used, as defined above, mention may also be made of the compounds of respective structures (I), (II) and (IIa) below:



(I)

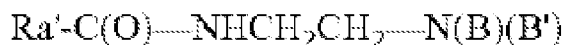
in which formula (I):

Ra represents a C₁₀-C₃₀ alkyl or alkenyl group derived from an acid Ra-COOH preferably present in hydrolysed coconut oil, or a heptyl, nonyl or undecyl group; Rb represents a beta-hydroxyethyl group; and

Rc represents a carboxymethyl group;

M⁺ represents a cationic counterion derived from an alkali metal or alkaline-earth metal, such as sodium, an ammonium ion or an ion derived from an organic amine; and

X⁻ represents an organic or mineral anionic counterion, such as that chosen from halides, acetates, phosphates, nitrates, (C₁-C₄)alkyl sulfates, (C₁-C₄)alkyl- or (C₁-C₄)alkylarylsulfonates, in particular methyl sulfate and ethyl sulfate; or alternatively M⁺ and X⁻ are absent;



(II)

in which formula (II):

B represents the group -CH₂-CH₂-O-X';

B' represents the group $-(CH^2)_zY'$, with $z=1$ or 2 ;

X' represents the group $-CH_2-COOH$, CH_2-COOZ' , $-CH_2CH_2-COOH$ or $-CH_2CH_2-COOZ'$, or a hydrogen atom;

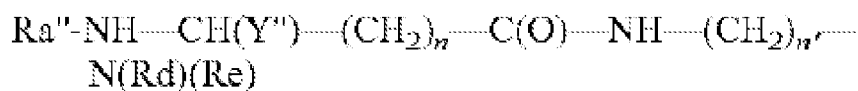
Y' represents the group $-COOH$, $-COOZ'$, $CH_2CH(OH)SO_3H$ or the group $-CH_2CH(OH)SO_3Z'$;

Z' represents a cationic counterion derived from an alkali metal or alkaline-earth metal, such as sodium, an ammonium ion or an ion derived from an organic amine;

Ra' represents a $C_{10}-C_{30}$ alkyl or alkenyl group of an acid $Ra'-COOH$, which may be coconut oil or in hydrolysed linseed oil, or an alkyl group, especially a C_{17} group and its iso form, or an unsaturated C_{17} group.

The compounds of this type are classified in the CTFA dictionary, 5th edition, 1993, under the names disodium cocoamphodiacetate, disodium lauroamphodiacetate, disodium caprylamphodiacetate, disodium capryloamphodiacetate, disodium cocoamphodipropionate, disodium lauroamphodipropionate, disodium caprylamphodipropionate, disodium capryloamphodipropionate, lauroamphodipropionic acid and cocoamphodipropionic acid.

By way of example, mention may be made of the cocoamphodiacetate sold by the company Rhodia under the trade name Miranol C2M Concentrate and the cocoamphodipropionate sold by the company Evonik Goldschmidt under the trade name Rewoteric AM KSF 40.



(IIa)

in which formula (IIa):

Y'' represents the group $-COOH$, $-COOZ''$, $-CH_2CH(OH)SO_3H$ or the group $-CH_2CH(OH)SO_3Z''$;

Rd and Re, independently of each other, represent a C_1-C_4 alkyl or hydroxyalkyl radical;

Z" represents a cationic counterion derived from an alkali metal or alkaline-earth metal, such as sodium, an ammonium ion or an ion derived from an organic amine;

Ra" represents a C₁₀-C₃₀ alkyl or alkenyl group of an acid Ra"-COOH;

5 n and n' denote, independently of each other, an integer ranging from 1 to 3; and mixtures of these compounds.

Among the compounds of formula (IIa), mention may be made of the compound classified in the CTFA dictionary under the name sodium diethylaminopropyl cocoaspartamide and sold by the company Chimex under the name Chimexane HB. In some instances, the amphoteric or zwitterionic surfactant(s)
10 are chosen from cocoylbetaine, cocoylamidopropylbetaine and sodium cocoylamidoethyl-N-hydro xyethylaminopropionate.

The term "anionic surfactant" means a surfactant comprising, as ionic or ionizable groups, only anionic groups. These anionic groups are chosen preferably
15 from the groups CO₂H, CO₂⁻, SO₃H, SO₃⁻, OSO₃H, OSO₃⁻, O₂PO₂H, O₂PO₂⁻ and O₂PO₂²⁻.

The anionic surfactant(s) that may be used may be alkyl sulfates, alkyl ether sulfates, alkylamido ether sulfates, alkylaryl polyether sulfates, monoglyceride sulfates, alkylsulfonates, alkylamide sulfonates, alkylarylsulfonates, alpha-olefin
20 sulfonates, paraffin sulfonates, alkylsulfosuccinates, alkyl ether sulfosuccinates, alkylamide sulfosuccinates, alkyl sulfoacetates, acylsarcosinates, acylglutamates, alkylsulfosuccinamates, acylisethionates and N-acyltaurates, salts of alkyl monoesters and polyglycoside-polycarboxylic acids, acyllactylates, salts of D-galactoside uronic acids, salts of alkyl ether carboxylic acids, salts of alkyl aryl ether
25 carboxylic acids, and salts of alkylamido ether carboxylic acids; or the non-salified forms of all of these compounds, the alkyl and acyl groups of all of these compounds containing from 6 to 24 carbon atoms and the aryl group denoting a phenyl group. Some of these compounds may be oxyethylenated and then preferably comprise from 1 to 50 ethylene oxide units.

30 The salts of C₆-C₂₄ alkyl monoesters of polyglycoside-polycarboxylic acids may be chosen from C₆-C₂₄ alkyl polyglycoside-citrates, C₆-C₂₄ alkyl polyglycoside-tartrates and C₆-C₂₄ alkyl polyglycoside-sulfo succinates.

When the anionic surfactant(s) are in salt form, they may be chosen especially from alkali metal salts such as the sodium or potassium salt and preferably the sodium salt, ammonium salts, amine salts and in particular amino alcohol salts, or alkaline-earth metal salts such as the magnesium salt.

5 Examples of amino alcohol salts that may especially be mentioned include monoethanolamine, diethanolamine and triethanolamine salts, monoisopropanolamine, diisopropanolamine or triisopropanolamine salts, 2-amino-2-methyl-1-propanol salts, 2-amino-2-methyl-1,3-propanediol salts and tris(hydroxymethyl)aminomethane salts. Alkali metal or alkaline-earth metal salts and
10 in particular the sodium or magnesium salts may be used.

Use is also made of (C₆-C₂₄)alkyl sulfates, (C₆-C₂₄)alkyl ether sulfates, which are optionally ethoxylated, comprising from 2 to 50 ethylene oxide units, and mixtures thereof, in particular in the form of alkali metal salts or alkaline-earth metal salts, ammonium salts or amino alcohol salts. More preferentially, the anionic
15 surfactant(s) are chosen from (C₁₀-C₂₀)alkyl ether sulfates, and in particular sodium lauryl ether sulfate containing 2.2 mol of ethylene oxide.

Oxidizing Agent

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

In some cases, the oxidizing agent is hydrogen peroxide present in an
25 aqueous solution whose titre may range from 1 to 40 volumes, such as from 5 to 40 volumes or such as from 5 to 20 volumes.

In other cases, the oxidizing agent is a persulfate and/or a monopersulfate such as, for example, potassium persulfate, sodium persulfate, ammonium persulfate, as well as mixtures thereof. In one embodiment, the oxidizing agents in
30 the present disclosure are selected from hydrogen peroxide, potassium persulfate, sodium persulfate, and mixtures thereof. Hydrogen peroxide may commonly be used as the oxidizing agent.

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

5 In some instances, the oxidizing composition is aqueous or is in the form of an emulsion.

In other instances, the oxidizing composition is substantially anhydrous. The term "substantially anhydrous" means that the oxidizing composition is either completely free of water or contains no appreciable amount of water, for example, no
10 more than 5% by weight, or no more than 2% by weight, or no more than 1% by weight, based on the weight of the oxidizing composition. It should be noted that this refers for example to bound water, such as the water of crystallization of the salts or traces of water absorbed by the raw materials used in the preparation of the compositions according to the disclosure.

15 The oxidizing composition can contain at least one solvent, chosen from water, organic solvents, and mixtures thereof. When the oxidizing composition is substantially anhydrous, the oxidizing composition may comprise at least one solvent chosen from organic solvents. Suitable organic solvents for use in the oxidizing composition include ethanol, isopropyl alcohol, propanol, benzyl alcohol, phenyl ethyl
20 alcohol, glycols and glycol ethers, such as propylene glycol, hexylene glycol, ethylene glycol monomethyl, monoethyl or monobutyl ether, propylene glycol and its ethers, such as propylene glycol monomethyl ether, butylene glycol, dipropylene glycol, diethylene glycol alkyl ethers, such as diethylene glycol monoethyl ether and monobutyl ether, ethylene glycol, propylene glycol, butylene glycol, hexylene glycol,
25 propane diol, glycerin, hydrocarbons such as straight chain hydrocarbons, mineral oil, polybutene, hydrogenated polyisobutene, hydrogenated polydecene, polydecene, squalane, petrolatum, isoparaffins, and mixtures, thereof.

The organic solvent may, for example, be present in an amount ranging from about 0.5% to about 70% by weight, such as from about 2% to about 60% by weight,
30 preferably from about 5 to about 50% by weight, relative to the total weight of the oxidizing composition.

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

The oxidizing composition of the present disclosure may also contain at least one fatty substance as described above. Thus, the total amount of fatty substances in the combination or mixture of the cosmetic and oxidizing compositions of the present disclosure may range from about 10% to about 80% by weight, or such as from about 20% to about 60% by weight, or such as from about 20% to about 40% by weight, or such as from about 20% to about 30% by weight, based on the total weight of the composition.

10 **Preservatives**

One or more preservatives may be included in the compositions described herein for treating hair. Suitable preservatives include, but are not limited to, glycerin containing compounds (e.g., glycerin or ethylhexylglycerin or phenoxyethanol), benzyl alcohol, parabens (methylparaben, ethylparaben, propylparaben, butylparaben, isobutylparaben, etc.), sodium benzoate, ethylenediamine-tetraacetic acid (EDTA), potassium sorbate, and/or grapefruit seed extract, or combinations thereof. More than one preservative may be included in the composition. Other preservatives are known in the cosmetics industries and include salicylic acid, DMDM Hydantoin, Formaldehyde, Chlorphenism, Triclosan, Imidazolidinyl Urea, Diazolidinyl Urea, Sorbic Acid, Methylisothiazolinone, Sodium Dehydroacetate, Dehydroacetic Acid, Quaternium-15, Stearalkonium Chloride, Zinc Pyrithione, Sodium Metabisulfite, 2-Bromo-2-Nitropropane, Chlorhexidine Digluconate, Polyaminopropyl biguanide, Benzalkonium Chloride, Sodium Sulfite, Sodium Salicylate, Citric Acid, Neem Oil, Essential Oils (various), Lactic Acid, and Vitamin E (tocopherol).

The preservative is optionally included in an amount ranging from about 0.01 wt.% to about 5 wt.%, about 0.15% to about 1 wt.%, or about 1 wt.% to about 3 wt.%, based on the total weight of the composition.

Viscosity Modifying Agents

30 The compositions may contain one or more viscosity modifying agents, such as viscosity increasing agents. Classes of such agents include, but are not limited to, viscous liquids, such as polyethylene glycol, semisynthetic polymers, such as

semisynthetic cellulose derivatives, synthetic polymers, such as carbomers, poloxamers, and polyethyleneimines (e.g., PEI-10), naturally occurring polymers, such as acacia, tragacanth, alginates (e.g., sodium alginate), carrageenan, vegetable gums, such as xanthan gum, petroleum jelly, waxes, particulate associate
5 colloids, such as bentonite, colloidal silicon dioxide, and microcrystalline cellulose, surfactants, such as PPG-2 hydroxyethyl coco/isostearamide, emulsifiers, such as disteareth-75 IPDI, and salts, such as sodium chloride, and combinations thereof.

Forms

The compositions described herein may be in any suitable physical form.
10 Suitable forms include, but are not limited to low to moderate viscosity liquids, lotions, milks, mousses, sprays, gels, creams, conditioners, and the like. Suitable excipients, such as those listed above, are included or excluded from the hair care formulation depending on the form of use of the formulation (e.g., hair spray, cream, conditioner, etc.).

15 i. Spray

The compositions described herein for treating hair may be in the form of a spray. The spray typically includes the composition comprising the one or more lactones and a cosmetically acceptable carrier. In some embodiments, the carrier is water or a water and alcohol mixture. The spray formulation optionally includes an
20 antioxidant, sunscreen agent, vitamin, protein, peptide, plant extract, humectant, oil, emollient, lubricant, thickener, hair conditioning agent, polymer, and/or surfactant. Preferably, the spray formulation includes a preservative. In some embodiments, the formulation includes a fragrance. In some cases, the compositions described herein include a surfactant. In some cases, the compositions described herein contain
25 water, fragrance, a preservative, and one or more lactones. In some cases, the compositions described herein contain water, fragrance, a preservative, and one or more lactones. In some cases, the composition comprising one or more lactones contains water, a preservative, fragrance, the one or more lactones, and an anti-static agent. In some cases, the compositions described herein contain water, a
30 preservative, fragrance, the one or more lactones, and a hair conditioning agent. In some cases, the compositions described herein contain water, a preservative, fragrance, the one or more lactones, and a surfactant.

The hair spray formulations may be dispensed from containers that include aerosol dispensers or pump spray dispensers. Such dispensers are known in the art and are commercially available from a variety of manufacturers.

When the hair spray formulation is dispensed from a pressurized aerosol container, a propellant may be used to force the composition out of the container. Suitable propellants include, but are not limited to, a liquefiable gas or a halogenated propellant. Examples of suitable propellants include dimethyl ether and hydrocarbon propellants such as propane, n-butane, iso-butane, CFCs, and CFC-replacement propellants. The propellants may be used singly or admixed.

The amount of propellant may range from about 10% to about 60% by weight of the formulation. The propellant may be separated from the hair repair formulation as in a two compartment container. Other suitable aerosol dispensers are those characterized by the propellant being compressed air, which can be filled into the dispenser using a pump or equivalent device prior to use. Conventional non-aerosol pump spray dispensers, i.e., atomizers, may also be used to apply the hair strengthening formulation to the hair.

ii. Conditioners

The compositions disclosed herein for treatment of hair may be in the form of a conditioner. The conditioner typically includes the composition comprising the one or more lactones in a suitable carrier. Additionally, the conditioner may include cationic polymers derived from polysaccharides, for example cationic cellulose derivatives, cationic starch derivatives, cationic guar derivatives and cationic locust bean gum derivatives, synthetic cationic polymers, mixtures or combinations of these agents. The formulation may comprise other synthetic or natural polymers or polymers derived from biological preparation processes, which are functionalized, where appropriate, for example with cationic or neutral groups. These polymers may have a stabilizing or strengthening action on the compositions, and/or a conditioning action (deposition on the surface of the skin or the hair).

iii. Creams

The compositions disclosed herein for treatment of hair may be in the form of a cream. The cream typically includes one or more lactones in a suitable carrier. The one or more lactones may be included in any suitable concentration. Typical concentrations of the one or more lactones in the cream range from small amounts
5 such as approximately about 0.01% (wt), at least 0.1% (wt), to large amounts, such as up to about 50% (wt).

Implementation of the present disclosure is provided by way of the following examples. The examples serve to illustrate the technology without being limiting in nature.

10

Examples

Example 1

Normal bleached hair swatches (from IHIP, about 1.5 grams) were treated
5 and evaluated as set forth below.

Pre-Color Treatment: Normal bleached hair swatches were treated with a pre-color treatment of either a 50 wt.% calcium chloride dihydrate solution or 40 wt.% trisodium citrate solution (0.5 g solution/1 g of hair).

Color Treatment Only: Hair swatches were colored using a commercial hair
10 coloring product (1 g color crème/1.5 g developer/1 g hair) for 30 minutes to give the hair an intense auburn color.

In-Color Treatment: Hair swatches were colored using a commercial color product that was combined with either a salt of a hydroxy-polycarboxylic acid (trisodium citrate) or an alkaline earth metal salt (calcium chloride) (1g solution of 50 wt.%
15 calcium chloride dihydrate or 40 wt.% trisodium citrate /1g color creme/1.5 g developer/1g hair) for 30 minutes to give the hair an intense auburn color.

Post-Color Treatment: The hair swatches were treated with a post-color treatment of either a 50 wt.% calcium chloride dihydrate or a 40 wt.% trisodium citrate (0.5 g solution/1 g of hair). The treated hair was allowed to stand at room temperature
20 overnight.

Hair Shampooing: The treated hair swatches were washed with an anionic shampoo (12% SLES, pH = 5.5) 10 times. The hair swatch were blown dry after each shampoo.

Color Assessment: The L^* and a^* values of the hair swatches were obtained before
25 and after 10 shampoos. The higher the L^* and the a^* values, the lighter and redder the hair, respectively. The $L^*a^*b^*$ colorimetric system is a colorimetric system that assigns each color to a position in a spherical color space. In this color space, the brightness is represented by a position in the ordinate (z-axis) direction, the hue is represented by a position in the circumferential direction, and the chroma is
30 represented by a distance from the center axis. The position on the ordinate (z-axis) representing brightness is designated by L^* , and the L^* value changes from 0 corresponding to black to 100 corresponding to white. The positive direction of the

x-axis corresponds to a red direction, the positive direction of the y-axis corresponds to a yellow direction, the negative direction of the x-axis corresponds to a green direction, the negative direction of the y-axis corresponds to a blue direction, and the position on the x-axis is designated by a^* of which value changes from -60 to +60 and the position on the y-axis is designated by b^* of which value changes from -60 to +60. The hue and chroma are represented by a^* value and b^* value, respectively.

The results of the treatments described above are provided below in tables 1-6.

TABLE 1				
Pre-color treatment (using salt of hydroxy-polycarboxylic acid) + In-Color Treatment (using alkaline earth metal salt)				
Treatment	L-Value		a-Value	
	Before	After	Before	After
No Treatment (control)*	27.5	34.9	16.8	15.4
Pre-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	27.9	36.0	18.8	16.5
In-color treatment using alkaline earth metal salt (CaCl_2)	24.1	33.3	12.9	17.1
Pre-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate) and in-color treatment using alkaline earth metal salt (CaCl_2)	24.4	32.8	14.0	17.3

* Colored hair without treatment with a salt of hydroxy-polycarboxylic acid or treatment with an alkaline earth metal salt.

TABLE 2				
Pre-color treatment (using alkaline earth metal salt) + In-Color Treatment (using salt of hydroxy-polycarboxylic acid)				
Treatment	L-Value		a-Value	
	Before	After	Before	After
No Treatment (control)*	27.6	34.3	17.2	16.2
Pre-color treatment using alkaline earth metal salt (CaCl ₂)	24.4	32.4	13.5	16.9
In-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	26.2	36.0	18.0	16.6
Pre-color treatment using alkaline earth metal salt (CaCl ₂) and in-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	24.7	32.0	14.8	17.4

* Colored hair without treatment with a salt of hydroxy-polycarboxylic acid or treatment with an alkaline earth metal salt.

TABLE 3				
Pre-color treatment (using salt of hydroxy-polycarboxylic acid) + Post-Color Treatment (using alkaline earth metal salt)				
Treatment	L-Value		a-Value	
	Before	After	Before	After
No Treatment (control)*	28.0	33.4	15.4	16.5
Pre-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	27.5	33.3	16.4	17.2
Post-color treatment using alkaline earth metal salt (CaCl ₂)	28.4	35.0	17.1	16.6
Pre-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate) and post-color treatment using alkaline earth metal salt (CaCl ₂)	25.3	31.5	15.9	17.6

* Colored hair without treatment with a salt of hydroxy-polycarboxylic acid or treatment with an alkaline earth metal salt.

TABLE 4				
Pre-color treatment (using alkaline earth metal salt) + Post-color treatment (using salt of hydroxy-polycarboxylic acid)				
Treatment	L-Value		a-Value	
	Before	After	Before	After
No Treatment (control)*	28.0	34.9	16.7	15.9
Pre-color treatment using alkaline earth metal salt (CaCl ₂)	24.6	34.7	10.9	16.5
Post-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	28.1	32.7	16.1	17.0
Pre-color treatment using alkaline earth metal salt (CaCl ₂) and post-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	23.8	31.7	10.6	17.9

* Colored hair without treatment with a salt of hydroxy-polycarboxylic acid or treatment with an alkaline earth metal salt.

TABLE 5				
In-Color Treatment (using salt of hydroxy-polycarboxylic acid) + Post-Color Treatment (using alkaline earth metal salt)				
Treatment	L-Value		a-Value	
	Before	After	Before	After
No Treatment (control)*	28.2	35.6	16.8	15.7
In-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	26.4	35.0	17.7	17.6
Post-color treatment using alkaline earth metal salt (CaCl ₂)	27.7	32.7	17.4	17.4
In-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate) and post-color treatment using alkaline earth metal salt (CaCl ₂)	27.2	30.6	17.7	18.7

* Colored hair without treatment with a salt of hydroxy-polycarboxylic acid or treatment with an alkaline earth metal salt.

TABLE 6				
In-Color treatment (using alkaline earth metal salt) + Post-color treatment (using salt of hydroxy-polycarboxylic acid)				
Treatment	L-Value		a-Value	
	Before	After	Before	After
No Treatment (control)*	29.0	34.7	17.8	15.6
In-color treatment using alkaline earth metal salt (CaCl ₂)	24.2	33.9	11.6	18.4
Post-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	28.6	34.9	17.4	16.5
In-color treatment using alkaline earth metal salt (CaCl ₂) and post-color treatment using salt of hydroxy-polycarboxylic acid (trisodium citrate)	26.0	33.4	14.2	18.5

* Colored hair without treatment with a salt of hydroxy-polycarboxylic acid or treatment with an alkaline earth metal salt.

- 5 As shown by the data in the tables above, the treatments with trisodium citrate provided better initial red color deposition but the color faded after 10 shampoos. The treatments with calcium chloride provided good initial darkness, but the redness lightened after 10 shampoos. Treatments with both the trisodium citrate and the calcium chloride provided the best results; the combination resulted in excellent
- 10 initial color deposition that was retained after 10 shampoos. Both the darkness and the red hue were unexpectedly retained after 10 shampoos.

Example 2
(Rinse-Off Post-Color Treatment Method)

Hair swatches (from IHIP, about 1.5 grams) were colored using a commercial hair coloring product (1 g color crème/1.5 g developer/1 g hair) for 30 minutes to give the hair an intense auburn color. These colored hair swatches were then treated with one of the following post-color treatments.

Post-color treatment with Hydroxy-Polycarboxylic Acid: The colored hair swatches were treated with 40 wt.% solution of citric acid (0.5 g solution/ 1 g hair). The solution of 40 wt.% citric acid was allowed to remain on the hair at room temperature for 20 minutes, then rinsed with water for 10 seconds.

Post-color treatment with Alkaline Earth Metal Salt: The colored hair swatches were treated (0.5 g solution/ 1 g hair) with 50 wt.% solution of calcium chloride (CaCl_2). The solution of 50 wt.% calcium chloride was allowed to remain on the hair at room temperature for 20 minutes, then rinsed with water for 10 seconds.

Post-color treatment with Both Hydroxy-Polycarboxylic Acid and Alkaline Earth Metal Salt: The colored hair swatches were treated with a solution comprising 25 wt.% citric acid and 25 wt.% calcium chloride (CaCl_2) (0.5 g solution/ 1 g hair). The solution was allowed to remain on the hair at room temperature for 20 minutes, then rinsed with water for 10 seconds.

The total change in hair color (ΔE) after shampooing 10 times was assessed based on the L^* , a^* , b^* , values. The $L^*a^*b^*$ colorimetric system is a colorimetric system that assigns each color to a position in a spherical color space. In this color space, the brightness is represented by a position in the ordinate (z-axis) direction. The position on the ordinate (z-axis) representing brightness is designated by L^* , and the L^* value changes from 0 corresponding to black to 100 corresponding to white. The positive direction of the x-axis corresponds to a red direction, the positive direction of the y-axis corresponds to a yellow direction, the negative direction of the x-axis corresponds to a green direction, the negative direction of the y-axis corresponds to a blue direction, and the position on the x-axis is designated by a^* of which value changes from -60 to +60 and the position on the y-axis is designated by b^* of which value changes from -60 to +60.

Treatment	L-Value		a-Value	
	Before	After	Before	After
No Post-color treatment (control)	26.5	34.5	16.4	15.4
Post-color treatment with Hydroxy-Polycarboxylic Acid (citric acid)	30.8	35.6	20.7	17.0
Post-color treatment with Alkaline Earth Metal Salt (CaCl ₂)	27.4	33.8	16.7	16.0
Post-color treatment with both Hydroxy-Polycarboxylic Acid (citric acid) and Alkaline Earth Metal Salt (CaCl ₂)	27.6	33.6	18.6	16.9

The ΔE for the control hair swatches was 8.9. The ΔE for the hair swatches treated with the combination of a hydroxy-polycarboxylic acid (citric acid) and an alkaline earth metal (CaCl₂) was 6.5. The higher the ΔE the more the color change
5 (more color fading) compared to the initial color.

The data show that compared to control, a post-color treatment with a hydroxy-polycarboxylic acid (citric acid) provides a more intense red color, even after being shampooed 10 times, but the color fades. Post-color treatment with an alkaline earth metal salt (CaCl₂) shows little effect on the intensity of the red color,
10 but helps prevent color fading. Post-color treatment with a combination of both a hydroxy-polycarboxylic acid (citric acid) and an alkaline earth metal (CaCl₂) provided significantly improved in color intensity and significantly less color fading. Thus, the post-color treatment with a combination of both a hydroxy-polycarboxylic acid (citric acid) and an alkaline earth metal (CaCl₂) improved the overall color profile of the
15 colored hair.

Example 3
(Leave-On Post-color treatment Method)

Hair swatches (from IHIP, about 1.5 grams) were colored using a commercial hair coloring product (1 g color crème/1.5 g developer/1 g hair) for 30 minutes to give the hair an intense auburn color. These colored hair swatches were treated with one of the following post-color treatments. The colored hair swatches were treated with a solution comprising 5 wt.% citric acid and 5 wt.% calcium chloride (CaCl_2) or with a solution comprising 10 wt.% citric acid and 10 wt.% calcium chloride (CaCl_2) (0.5 g solution/ 1 g hair).

The total change in hair color (ΔE) after shampooing 10 times was assessed based on the L^* , a^* , b^* , values. The higher the ΔE the more the color change (more fading) compared to the initial color.

Treatment	ΔE After Shampooing 10 Times
Typical Color Treatment (Control) (no alkaline earth metal salt)	9.1
Post-color treatment with both 5 wt.% Hydroxy-Polycarboxylic Acid (citric acid) and 5 wt.% Alkaline Earth Metal Salt (CaCl_2)	4.3
Post-color treatment with both 10 wt.% Hydroxy-Polycarboxylic Acid (citric acid) and 10 wt.% Alkaline Earth Metal Salt (CaCl_2)	2.6

The data show that hair treated with a leave-on post-color treatment comprising both a hydroxy-polycarboxylic acid and a hydroxy-polycarboxylic acid exhibited significantly better color protection against shampooing than control.

Example 4

(In-Color Treatment and Post-color treatment Method)

Hair swatches (from IHIP, about 1.5 grams) were subjected to one of the following four treatments.

- 5 **Typical Color Treatment:** Hair swatches were colored using a commercial hair coloring product (1 g color crème/1.5 g developer/1 g hair) for 30 minutes to give the hair an intense auburn color.

- 10 **In-Color Treatment with Alkaline Earth Metal Salt:** Hair swatches were colored with the same commercial hair coloring product above, except that an alkaline earth metal salt (CaCl_2) was included with the coloring composition (1 g of 30 wt.% CaCl_2 /1 g color crème/1.5 g developer/1 g hair). The hair was treated with the coloring composition for 30 minutes to give the hair an intense auburn color.

- 15 **Post-Color Treatment with Hydroxy-Polycarboxylic Acid:** Hair swatches were colored using a commercial hair coloring product (1 g color crème/1.5 g developer/1 g hair) for 30 minutes to give the hair an intense auburn color. After coloring, the hair swatches were treated with a composition comprising hydroxy-polycarboxylic acid (10 wt.% solution of citric acid) (0.5 g solution/ 1 g hair). The post-treated hair was allowed to stand at room temperature overnight.

- 20 **In-Color Treatment with Alkaline Earth Metal Salt and Post-color treatment with Hydroxy-Polycarboxylic Acid:** Hair swatches were treated with both the In-Color Treatment (with alkaline earth metal salt) and the Post-color treatment (with hydroxy-polycarboxylic acid), as described above.

- 25 The total change in hair color (ΔE) after shampooing 10 times was assessed based on the L^* , a^* , b^* , values. The higher the ΔE the more the color change (more fading) compared to the initial color.

Treatment	ΔE After Shampooing 10 Times
Typical Color Treatment (Control) (no alkaline earth metal salt)	6.8
In-Color Treatment With Alkaline Earth Metal Salt (CaCl_2)	15.0
Post-Color treatment with Hydroxy-Polycarboxylic Acid (Citric Acid)	4.5
Both In-Color Treatment with Alkaline Earth Metal Salt (CaCl_2) and Post-Color treatment with Hydroxy-Polycarboxylic Acid (Citric Acid)	3.9

The data show that the hair treated with an alkaline earth metal salt (CaCl_2) during the coloring process and subsequently post-treated with a hydroxy-polycarboxylic acid composition (inventive treatment) exhibited significantly less color fading than all other treatments. The hair treated according to the inventive method exhibited significant improvement in both color intensity and color retention.

The terms “a,” “an,” and “the” are understood to encompass the plural as well as the singular.

The expression “at least one” means “one or more” and vice versa, and thus includes individual components as well as mixtures/combinations.

The term “about” when referring to a value, is meant specifically that a measurement can be rounded to the value using a standard convention for rounding numbers. For example, “about 1.5” is 1.45 to 1.54. All values set forth herein can be modified with the term “about,” if desired to impart the meaning above, or recited without the term in order to have their ordinary meaning, regardless of whether the term “about” is specifically set forth (or is absent) in conjunction with any particular value in the specification.

When referring to “compositions described herein,” all types of compositions are intended unless specifically described otherwise. The “compositions disclosed herein” include the compositions comprising one or more reducing agent, the composition comprising one or more lactones, to oxidizing compositions, etc.

All ranges and values disclosed herein are inclusive and combinable. For examples, any value or point described herein that falls within a range described herein can serve as a minimum or maximum value to derive a sub-range, etc.

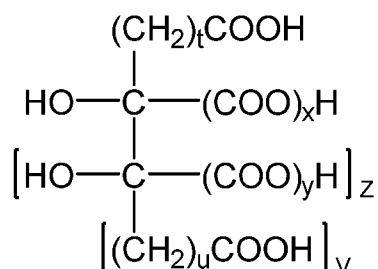
All publications and patent applications cited in this specification are herein incorporated by reference, and for any and all purposes, as if each individual publication or patent application were specifically and individually indicated to be incorporated by reference. In the event of an inconsistency between the present
5 disclosure and any publications or patent application incorporated herein by reference, the present disclosure controls.

10

Claims

1. A method for artificially coloring hair and inhibiting the coloring from fading, the method comprising:

- 5 (a) treating hair with a pre-color treatment composition comprising about 1 wt.% to about 75 wt.% of one or more alkaline earth metal salts or about 1 wt.% to about 75 wt.% of one or more salts of a hydroxy-polycarboxylic acid, wherein hydroxy-polycarboxylic acid has the formula:



10 wherein, x and y are independently 0 or 1; and

t, u, v, and z are independently 0 to 3; and

- 15 (b) treating the hair with a coloring composition comprising about 1 wt.% to about 50 wt.% of the one or more alkaline earth metal salts or about 1 wt.% to about 50 wt.% of the one or more salts of a hydroxy-polycarboxylic acid;

provided that when the one or more alkaline earth metal salts is used in the pre-color treatment composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the coloring composition, and vice versa.

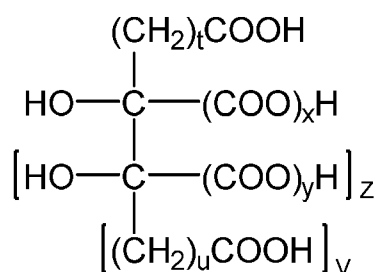
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2. The method of claim 1, wherein the one or more salts of the hydroxy-polycarboxylic acid are salts of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and/or 2-hydroxy n-butyl 1,3,4-tricarboxylic acid.

25

3. The method of claim 1 or claim 2, wherein the one or more salts of the hydroxy-polycarboxylic acid comprises trisodium citrate.

- 4 The method of any one of the above claims, wherein the one or more alkaline earth metal salts are selected from the group consisting of magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium phosphate,
- 5 magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate.
5. The method of any one of the above claims, wherein the pre-treatment composition of (a) is applied to the hair and allowed to remain on the hair for
- 10 about 1 minute to about 1 hour at a temperature of about 25°C to about 45°C before treatment with the coloring composition of (b).
6. A kit comprising both a pre-color treatment composition and a coloring composition, as defined in any one of the above claims.
- 15
7. A method for artificially coloring hair and inhibiting the coloring from fading, the method comprising:
- (a) treating hair with a pre-color treatment composition comprising about 1
- 20 wt.% to about 75 wt.% of one or more alkaline earth metal salts or about 1 wt.% to about 75 wt.% of one or more salts of a hydroxy-polycarboxylic acid of the formula



- wherein, x and y are independently 0 or 1; and
- 25 t, u, v, and z are independently 0 to 3; and
- (b) treating the hair with a coloring composition; and
- (c) treating the hair with a post-color treatment composition comprising about 1 wt.% to about 75 wt.% of the one or more alkaline earth metal

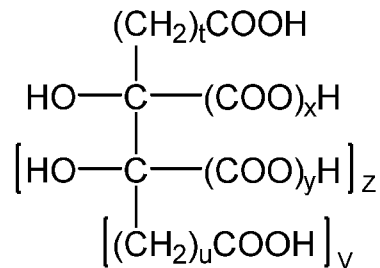
salts or about 1 wt.% to about 75 wt.% of the one or more salts of a hydroxy-polycarboxylic acid;

provided that when the one or more alkaline earth metal salts is used in the pre-color treatment composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the post-color treatment compositions, and vice versa.

8. The method of claim 7, wherein the one or more alkaline earth metal salts are selected from the group consisting of magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate.
9. The method of claim 7 or claim 8, wherein the one or more alkaline earth metal salts of (a) comprises calcium chloride.
10. The method of any one of claims 7-9, wherein the one or more salts of the hydroxy-polycarboxylic acid are salts of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and/or 2-hydroxy n-butyl 1,3,4-tricarboxylic acid.
11. The method of any one of claims 7-10, wherein the pre-treatment composition of (a) is applied to the hair and allowed to remain on the hair for about 1 minute to about 1 hour at a temperature of about 25°C to about 45°C before treatment with the coloring composition of (b); and the post-treatment composition of (c) is applied to the hair within about 1 hour of the hair being artificially colored and is allowed to remain on the hair for about 1 minute to about 1 hour at a temperature of about 20°C to about 45°C.
12. A kit comprising both a pre-color treatment composition and a coloring composition, as defined in any one of claims 7-11.

13. A method for artificially coloring hair and inhibiting the coloring from fading, the method comprising:

- (a) treating the hair with a coloring composition comprising about 1 wt.% to about 50 wt.% of one or more alkaline earth metal salts or about 1 wt.% to about 50 wt.% of one or more salts of a hydroxy-polycarboxylic acid, wherein hydroxy-polycarboxylic acid has the formula:



wherein, x and y are independently 0 or 1; and

t, u, v, and z are independently 0 to 3; and

- (b) treating the hair with a post-color treatment composition comprising about 1 wt.% to about 75 wt.% of the one or more alkaline earth metal salts or about 1 wt.% to about 75 wt.% of the one or more salts of a hydroxy-polycarboxylic acid;

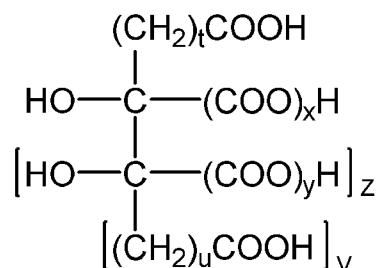
provided that when the one or more alkaline earth metal salts is used in the coloring composition, the one or more salts of the hydroxy-polycarboxylic acid is used in the post-color treatment composition, and vice versa.

14. The method of claim 13, wherein the one or more alkaline earth metal salts of are selected from the group consisting of magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate.

15. The method of claim 13 or claim 14, wherein post-treatment composition of (b) is applied to the hair within about 1 hour of the hair being artificially colored

and is allowed to remain on the hair for about 1 minute to about 1 hour at a temperature of about 20°C to about 45°C.

16. The method of any one of claims 13-15, wherein the one or more salts of the hydroxy-polycarboxylic acid are salts of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and/or 2-hydroxy n-butyl 1,3,4-tricarboxylic acid.
17. The method of any one of claims 13-16, wherein the one or more salts of the hydroxy-polycarboxylic acid comprises trisodium citrate.
18. A kit comprising both a pre-color treatment composition and a coloring composition, as defined in any one of claims 12-17.
19. A method for artificially coloring hair and inhibiting the color from fading, the method comprising:
 - treating the hair with a coloring composition;
 - treating the hair one or more alkaline earth metal salts; and
 - treating the hair with one or more salts of a hydroxy-polycarboxylic acid,
 wherein hydroxy-polycarboxylic acid has the formula:

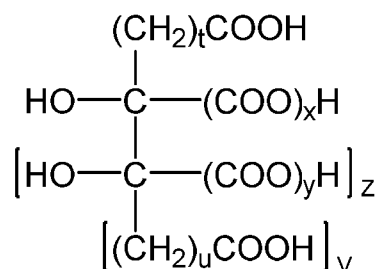


wherein, x and y are independently 0 or 1; and

t, u, v, and z are independently 0 to 3;

- wherein the one or more alkaline earth metal salts and the one or more hydroxyl-polycarboxylic acids are applied to the hair separately; and wherein the one or more earth metal salts or the one or more hydroxyl-polycarboxylic acids applied to the hair as a pre-color treatment, an in-color treatment, or a post-color treatment.

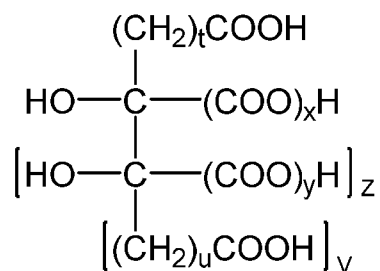
20. A method for inhibiting color fading of artificially colored hair comprising applying to the artificially colored hair a post-color treatment composition comprising one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids of the formula



wherein, x and y are independently 0 or 1; and
t, u, v, and z are independently 0 to 3.

21. The method of claim 20, wherein the one or more alkaline earth metal salts are selected from the group consisting of magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate.
22. The method of claim 20 or claim 21, wherein the one or more alkaline earth metal salts comprises calcium chloride.
23. The method of any one of claims 20-22, wherein the one or more hydroxy-polycarboxylic acids are selected from the group consisting of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and 2-hydroxy n-butyl 1,3,4-tricarboxylic acid.
24. The method of any one of claims 20-23, wherein the one or more hydroxy-polycarboxylic acids comprises citric acid.

25. The method of any one of claims 20-24, wherein the post-color treatment composition comprises about 1 to about 50 wt.% of the one or more alkaline earth metal salts and about 1 to about 50 wt.% of the one or more hydroxy-polycarboxylic acids.
- 5 26. The method of any one of claims 20-25, wherein the post-color treatment composition is applied to the artificially colored hair within 24 hours of the hair being artificially colored.
- 10 27. The method of any one of claims 20-26, wherein the post-color treatment composition is applied to the artificially colored hair within about 1 hour of the hair being artificially colored and is allowed to remain on the hair for about 1 minute to about 1 hour at a temperature of about 20°C to about 45°C.
- 15 28. The method of any one of claims 20-27, wherein the post-color treatment composition is allowed to remain on the hair for at least 5 minutes after application.
- 20 29. A method for artificially coloring hair and inhibiting the coloring from fading, the method comprising:
- (a) treating hair with a coloring composition comprising one or more alkaline earth metal salts and coloring the hair; and
 - (b) subsequently treating the hair with a post-color treatment composition comprising one or more hydroxy-polycarboxylic acids of the formula

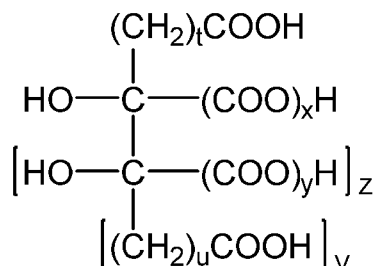


wherein, x and y are independently 0 or 1; and
 t, u, v, and z are independently 0 to 3.
 z is 0 to 3.

30. The method of claim 29, wherein the one or more alkaline earth metal salts are selected from the group consisting of magnesium chloride, magnesium sulfate, magnesium nitrate, magnesium acetate, magnesium carbonate and hydrogencarbonate, magnesium phosphate, magnesium oxalate, calcium chloride, calcium nitrate, calcium acetate, calcium hydrogen carbonate, strontium chloride, strontium nitrate, barium chloride, and barium nitrate.
31. The method of claim 29 or claim 30, wherein the one or more alkaline earth metal salts comprises calcium chloride.
32. The method of any one of claims 29-31, wherein the one or more hydroxy-polycarboxylic acids are selected from the group consisting of citric acid, tartaric acid, malic acid, 2-hydroxy malonic acid, 2-hydroxyl n-butyl 1,2,4-tricarboxylic acid, glucaric acid, and 2-hydroxy n-butyl 1,3,4-tricarboxylic acid.
33. The method of any one of claims 29-32, wherein the one or more hydroxy-polycarboxylic acids comprises citric acid.
34. The method of any one of claims 29-33, wherein the coloring composition of (a) comprises about 1 to about 50 wt.% of the one or more alkaline earth metal salts, based on the total weight of the composition of (a); and the post-color treatment composition of (b) comprises about 1 to about 50 wt.% of the one or more hydroxy-polycarboxylic acids, based on the total weight of the post-color treatment composition of (b).
35. The method of any one of claims 29-34, wherein the post-color treatment composition is applied to the artificially colored hair within 1 hour of the hair being artificially colored and is allowed to remain on the hair for about 1 minute to about 1 hour at a temperature of about 20°C to about 45°C.
36. The method of any one of claims 29-35, wherein the coloring composition of (a) comprises an oxidative dye.

37. A post-color treatment composition comprising:

- (a) one or more alkaline earth metal salts; and
- (b) optionally, one or more hydroxy-polycarboxylic acids of the formula



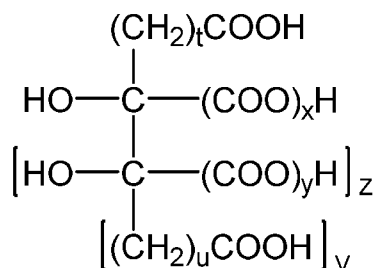
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wherein, x and y are independently 0 or 1; and
t, u, v, and z are independently 0 to 3.

38. A kit comprising:

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- (i) a coloring composition; and separately
- (ii) a post-color treatment composition comprising one or more alkaline earth metal salts and one or more hydroxy-polycarboxylic acids of the formula



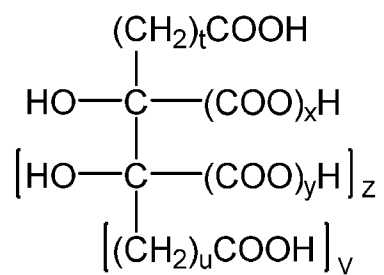
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wherein, x and y are independently 0 or 1; and
t, u, v, and z are independently 0 to 3;
or

a kit comprising:

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- (i) a coloring composition comprising one or more alkaline earth metal salts; and
- (ii) a post-color treatment composition comprising one or more hydroxy-polycarboxylic acids of the formula



wherein, x and y are independently 0 or 1; and
t, u, v, and z are independently 0 to 3.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/32140

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 4-6, 10-12, 16-18, 23-28 & 32-36
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/32140

A. CLASSIFICATION OF SUBJECT MATTER

IPC - A61K 8/362, 8/365; A61Q 5/10 (2017.01)

CPC - A61K 8/362, 8/365; A61Q 5/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2014/203771 A1 (HODOGAYA CHEM CO LTD) [English translation] 24 December 2014; page 1, paragraph 2; page 4, paragraphs 3-6; page 7, paragraph 3; page 9, paragraph 4	1-2, 3/1-2, 7-8, 9/7-8, 13-14, 15/13-14, 19
Y	US 2002/0189031 A1 (JAVET, M et al.) 19 December 2002; paragraphs [0007]-[0015], [0022]	1-2, 3/1-2, 7-8, 9/7-8, 19
Y	US 2001/0007160 A1 (YAMAGUCHI, M et al.) 12 July 2001; paragraphs [0001], [0007]-[0012], [0016]-[0017], [0027], [0029]	7-8, 9/7-8, 13-14, 15/13-14, 20-21, 22/20-21, 29-30, 31/29-30, 37-38
Y	DE 10 2005 062 360 A1 (HENKEL AG & CO KGAA) [English translation] 28 June 2007; paragraphs [0001], [0003], [0007], [0009], [0019], [0068]	20-21, 22/20-21, 37-38
Y	US 5,006,127 A (TENNIGKEIT, J et al.) 09 April 1991; column 1, lines 6-12, 50-62; column 2, lines 14-22; claim 3	29-30, 31/29-30
Y	US 2004/0158940 A1 (WELLS, RL et al.) 19 August 2004; paragraphs [0009]-[0012], [0019]; [0089], [0140]	13-14, 15/13-14
Y	US 2010/0242982 A1 (PREM, P et al.) 30 September 2010; paragraphs [0015], [0017], [0019]	38

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

15 July 2017 (15.07.2017)

Date of mailing of the international search report

04 AUG 2017

Name and mailing address of the ISA/

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Shane Thomas

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