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(54) **ALUMINUM-CONTAINING HIGH GLOSS
COATING FOR NATURAL AND ARTIFICIAL
FINGERNAILS**

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ABSTRACT

Related U.S. Application Data

(60) Provisional application No. 62/023,364, filed on Jul.
11, 2014.

A decorative laminate for natural or artificial fingernails hav-
ing at least one internal layer formed from a dried film former-
free suspension of aluminum platelets.

ALUMINUM-CONTAINING HIGH GLOSS COATING FOR NATURAL AND ARTIFICIAL FINGERNAILS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.S. Provisional patent application 62/023,364 filed Jul. 11, 2014, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

[0002] This invention relates to the field of metallic-appearing coatings useful for cosmetic adornment of natural fingernails and toenails, artificial fingernails and toenails, and artificial nail extensions.

[0003] More particularly the invention relates to the field of actinic radiation cured coatings for such nails.

[0004] The use of radiation-curable gels in formation of nail enhancements or artificial nails has been an important part of the cosmetic industry since it was first introduced. U.S. Pat. No. 4,682,612, describing the use of actinic radiation-curable compositions suitable for preparation of artificial nails, is representative of this technology.

[0005] Ultra-violet radiation (UV) is the most conventional form of radiation used to cure gels in this art. Professional nail technicians most typically apply UV curable gels which are usually composed of acrylic or methacrylic monomers and oligomers in a gel-like state that requires curing under a UV lamp. Typically these can be broad wavelength lamps or narrow wavelength lamps based on Light Emitting Diodes (LED). Visible light curing can also be used. Such nail finishes can be applied directly to natural fingernails or toenails, or alternatively can be applied to nail extensions bonded to fingernails.

[0006] A wide variety of colors and finishes are used by the nail technicians to achieve a desired appearance of the natural or artificial nail. Various attempts have been described in the art to impart a metallic finish to nails. See, for example, Ilekki, et al., US Pat. Pub. 2009/0126316, which describes a flexible article with an optical relief comprising an adhesive layer, an organic film, and a material with an optical relief, or olfactory effect, wherein the organic film may contain various metallic particles; and U.S. Pat. No. 6,565,835 which describes a nail enamel composition of non-toxic components for forming a film over natural or synthetic human nails, comprising a film forming component, a solvent, and aluminum platelets, said film having a haze value greater than 932 HU.

[0007] The prior systems for coating such nails do not provide acceptable mirror-like metallic finishes for various reasons.

[0008] It is an object of the present invention to provide mirror-like metallic finish systems for such nails.

SUMMARY OF THE INVENTION

[0009] This object and others which will become apparent from the following description are achieved by the present invention which comprises in one aspect a multi-layer cosmetic laminate for decorating natural or artificial human nails comprised of at least three layers, a UV cured coating as the first layer, a layer comprising aluminum platelets as the second layer, and another UV cured coating layer as the third layer, the second layer which comprises aluminum platelets being substantially free of film former.

[0010] Another aspect of the invention comprises a method of decorating natural or artificial human nails comprising

[0011] a) applying a first layer comprising a UV curable gel coating composition comprising one or more ethylenically unsaturated monomers, one or more ethylenically unsaturated oligomers, or mixtures of said ethylenically unsaturated monomer or monomers and said ethylenically unsaturated oligomer or oligomers, and a photoinitiator;

[0012] b) curing the first layer under UV radiation;

[0013] c) applying a second layer comprising aluminum platelets which is substantially free of film former;

[0014] d) applying a third layer comprising the UV curable gel coating composition; and

[0015] e) curing the third layer under UV radiation.

[0016] The laminate is not limited to three layers in that additional layers can be provided before, after, or between two of the three layers. The additional layers can be metallic, adhesive, UV cured gels, or enamel.

[0017] Very reflective composites are provided, having a haze value in most cases substantially greater than 950 HU.

[0018] As is conventional, in most embodiments UV cured coating layers are each formed by curing under UV radiation a composition comprising one or more ethylenically unsaturated monomers, one or more ethylenically unsaturated oligomers, or mixtures of said ethylenically unsaturated monomer or monomers and said ethylenically unsaturated oligomer or oligomers, and a photoinitiator. It is also possible for said coatings to contain only a monomer or monomers or only an oligomer or oligomers.

[0019] Preferably the monomers and/or oligomers are selected from mono-, di-, tri-, and tetra-functional ethylenically unsaturated monomers and/or oligomers and are most preferably at least in part (meth)acrylic such as aliphatic polyester or polyether based urethane diacrylate oligomers.

[0020] According to this invention the layer comprising aluminum platelets is formed subsequent to curing the first base coat layer by coating the cured first base coat layer with a suspension of aluminum platelets in solvent and then evaporating the solvent to form a dry coating of aluminum.

[0021] According to this invention the uncured layer of base coat which may result during the curing to form the base coat layer, known in the art as the tacky layer, is removed using a suitable solvent, such as isopropanol, prior to application of the suspension of aluminum platelets.

[0022] According to this invention the uncured layer of top coat which may result during the curing to form the top coat layer, known in the art as the tacky layer, is removed using a suitable solvent, such as isopropanol after curing.

[0023] The preferred solvents for the aluminum platelet suspension are those most widely used in the enamel nail coating art, namely ethyl acetate, butyl acetate, acetone, isopropanol and mixtures thereof

[0024] Preferably the third coat and any other coats over the aluminum platelet layer are free of pigment so that the metal appearance of the aluminum layer is clearly visible.

[0025] The suspension of aluminum platelets can contain a leafing agent, for example a long chain phosphoric acid ester.

[0026] The aluminum platelets of the second layer can be made by a variety of methods, for example one which comprises physical vapor deposition. Aluminum platelets are available, for example, from Schlenk under the Decomet® trademark, Eckart Division of Altana under the Metalure®

trademark and Silberline under the Starbrite® trademark. One preferred brand of aluminum platelets is the Decomet® brand.

[0027] The suspension of aluminum platelets may contain a viscosity modifier which is not a film former.

[0028] In some embodiments the aluminum platelets are multi-layered effect pigments created by physical vapor deposition having an aluminum core with MgF₂ layers deposited thereon and a grating with a defined spacing between grating structures embossed on these low refracting layers which produces a prismatic rainbow-like diffraction effect when observed under visible light.

[0029] The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While the invention has been depicted and described and is defined by reference to particular preferred embodiments of the invention, such references do not imply a limitation on the invention, and no such limitation is to be inferred. The invention is capable of considerable modification, alteration and equivalents in form and function, as will occur to those ordinarily skilled in the pertinent arts. The depicted and described preferred embodiments of the invention are exemplary only and are not exhaustive of the scope of the invention. Consequently, the invention is intended to be limited only by the spirit and scope of the appended claims, giving full cognizance to equivalents in all respects.

DETAILED DESCRIPTION

[0030] Examples of urethane(meth)acrylates, useful in the present invention have at least one, preferably two or more acryloyl, or methacryloyl groups and a urethane group. Examples include urethanes based on aliphatic, aromatic, polyester, and polyether polyols and aliphatic, aromatic, polyester, and polyether diisocyanates capped with (meth)acrylate endgroups and urethane (meth)acrylates made from reaction of aliphatic or aromatic isocyanates with hydroxyl containing (meth)acrylic monomers or oligomers. Other oligomers useful in the invention include epoxy (meth)acrylates and epoxy urethane (meth)acrylates having at least one, preferably two or more two or more acryloyl or methacryloyl groups and, optionally a urethane group. Examples include epoxy (meth)acrylates based on aliphatic or aromatic epoxy prepolymers capped with a urethane group (meth)acrylate end group. An aliphatic or aromatic urethane spacer can be optionally inserted between the epoxy and the (meth)acrylate end group(s). (Meth)acrylated polyester oligomers, useful in the present invention have at least one, preferably two or more acryloyl or methacryloyl groups and a polyester core. (Meth)acrylated acrylate oligomers, useful in the present invention, have at least one, preferably two or more acryloyl or methacryloyl groups and a polyacrylic core. (Meth)acrylated polyether oligomers useful in the invention have at least one, preferably two or more acryloyl or methacryloyl groups and a polyether core. (Meth)acrylated cellulose oligomers useful in the invention have at least one, preferably two or more acryloyl groups and a cellulose core. Cellulose based urethanes and maleates containing acryloyl, methacryloyl, styrenic or maleate groups may also be used. Butadiene oligomers have at least one, preferably two or more acryloyl or methacryloyl groups and optionally at least one urethane functionality. (Meth)acrylated styrene/maleic oligomers have at least one, preferably two or more (meth)acryloyl groups attached to a styrene/maleic anhydride core. These materials

can be made by methods well known in the art and are available from several suppliers including Bayer, BASF, Dymax, Allnex, DSM Neoresins, Eternal Chemical Company, IGM Resins, Rahn AG, Sartomer Division of Arkema, Esstech Resins, Miwon, Double Bond Chemical, Kowa, Soltech and SI Group. Mixtures of these oligomers may also be used.

[0031] In addition to the above-described (meth)acrylate-based polymerizable materials, other polymerizable monomers, oligomers or polymers of monomers which contain at least one free radical polymerizable group in the molecule may be used without any limitations in the curable gel. Typical examples include esters of acrylic and methacrylic acid, herein termed (meth)acrylic ester. Specific but not limiting examples of mono (meth)acryloyl esters include methyl (meth)acrylate, ethyl (meth)acrylate, hydroxypropyl (meth)acrylate, butyl (meth)acrylates, hydroxy ethyl (meth)acrylates, butoxyethyl (meth)acrylate, diethylaminoethyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, ethoxyethyl (meth)acrylate, t-butyl aminoethyl (meth)acrylate, methoxyethylene glycol (meth)acrylate, phosphoethyl (meth)acrylate, methoxy propyl (meth)acrylate, methoxy polyethylene glycol(meth)acrylate, phenoxyethylene glycol (meth)acrylate, phenoxypolyethylene glycol (meth)acrylate, 2-hydroxy-3-phenoxypropyl (meth)acrylate, 2-(meth)acryloxyethylsuccinic acid, 2-(meth)acryloxyethylphthalic acid, 2-(meth)acryloxypropylphthalic acid, stearyl (meth)acrylate, isobornyl (meth)acrylate, 3-chloro-2-hydroxypropyl (meth)acrylates, tetrahydrofurfuryl (meth)acrylate, methacryloxyethyl trimellitic anhydride, (meth)acrylamides and allyl monomers. Specific but not limiting examples of difunctional (meth)acryloyl esters include 1,4 butane diol di(meth)acrylate, 1,6 hexanediol di(meth)acrylate, alkoxyated hexane diol di(meth)acrylate, 1,9 nonanediol di(meth)acrylate, 1,10 decanediol di(meth)acrylate, neopentyl glycol di(meth)acrylate, alkoxyated neopentyl glycol di(meth)acrylate, 2-methyl-1,8-octane diol di(meth)acrylate, cyclohexane dimethanol di(meth)acrylate, glycerin di(meth)acrylate, ethylene glycol di(meth)acrylate, triethyleneglycol di(meth)acrylate, polyethylene glycol di(meth)acrylate, propylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, ethoxyated propylene glycol di(meth)acrylate, ethoxyated polypropylene glycol di(meth)acrylate, polyethoxypropoxy di(meth)acrylate, ethoxyated bisphenol A di(meth)acrylate, propoxyated bisphenol A di(meth)acrylate, propoxyated ethoxyated bisphenol A di(meth)acrylate, bisphenol A glycidyl methacrylate, tricyclodecanedimethanol di(meth)acrylate, glycerin di(meth)acrylate, ethoxyated glycerin di(meth)acrylate, bis acrylamides, bis allyl ethers and allyl (meth)acrylates. Examples of tri and or higher (meth)acryloyl esters include trimethylol propane tri(meth)acrylate, ethoxyated glycerin tri(meth)acrylate, ethoxyated trimethylolpropane tri(meth)acrylate, ditrimethylol propane tetra(meth)acrylate, pentaerythritol tri(meth)acrylate, pentaerythritol tetra(meth)acrylate, propoxyated pentaerythritol tetra(meth)acrylate, ethoxyated pentaerythritol tetra(meth)acrylate, dipentaerythritol hexa(meth)acrylate, dipentaerythritol penta(meth)acrylate and ethoxyated iscyanuric acid tri(meth)acrylates. Monomers containing acid groups may also be used including (meth)acrylic acid, bis(glyceryl dimethacrylate) pyromellitate, pyromellitic dimethacrylate, methacryloxyethyl phthalate, methacryloxyethyl maleate, 2 hydroxyethyl methacrylate/succinate, 1,3 glyceryl dimethacrylate maleate adduct, and 1,3 glyceryl dimethacrylate succinate adduct. Partially aminated monomers and oli-

gomers may also be used. These are prepared by reaction of amines, preferably secondary amines, with some of the (meth)acryloyl groups of the multifunctional monomers or oligomers.

[0032] A compound having at least one free radical polymerizable group includes not only a single component but also a mixture of polymerizable monomers. Thus combinations of two or more materials containing free radical polymerizable groups may be used.

[0033] The gels also contain a photoinitiator. Examples of these include benzyl ketones, monomeric hydroxyl ketones, polymeric hydroxyl ketones, alpha-amino ketones, acyl phosphine oxides, phosphinates, metallocenes, benzophenone, benzophenone derivatives, and the like. Specific examples include 1-hydroxy-cyclohexylphenylketone, 2,2-dimethoxy 2-phenyl acetophenone, 2-hydroxy-2-methyl-1-phenyl-1-propanone, alpha, alpha-dimethoxy aliphatic phenyl acetophenone, benzophenone, 2-benzyl-2-(dimethylamino)-1-(4-(4-morpholinyl)phenyl)-1-butanone, 2-methyl-1-(4-methylthio)phenyl-2-(4-morpholinyl)-1-propanone, diphenyl-(2,4,6-trimethylbenzoyl) phosphine oxide, phenyl bis(2,4,6-trimethylbenzoyl) phosphine oxide, benzyl-dimethylketal, isopropylthioxanthone, ethyl (2,4,6-trimethyl benzoyl) phenyl phosphinate and phenyl (2,4,6-trimethyl benzoyl) phenyl phosphinate, methyl benzoyl formate, and mixtures thereof

[0034] Photo accelerators such as aliphatic or aromatic amines may also be included in the gel as well as fillers, inhibitors, plasticizers, non reactive polymers, solvents and adhesion promoters.

[0035] By the term "gel," we mean a radiation-curable composition comprising photoinitiator, ethylenically unsaturated monomers and/or oligomers, having a viscosity suitable for coating natural or artificial nails, or forming artificial nails and extensions, as well as adorning such nails.

[0036] The aluminum platelets are generally dispersed in a pharmacologically acceptable solvent. This solution may contain viscosity modifiers to help maintain suspension of the platelets. Examples of inorganic based modifiers useful in the invention include but are not limited to: calcium, zinc or aluminum stearate, silica, fumed silica such as that available as Aerosil® from Evonik Industries or Cab-O-Sil® available from Cabot Corporation, diatomaceous earth, bentonite clay, kaolinite, pyrophyllite, sericite, saponite, smectic/vermiculites (montmorillonite, beidellite, nontronite, hectorite and saponite), organic modified clays including but not limited to stearylalkonium or distearylalkonium bentonite and hectorite and others that are available from Elementis Specialties under the trade name of Bentone® and Garamites® from Rockwood Additives such as Garamite® 1958, talc, mica, zirconium oxide, zinc oxide and magnesium oxide. Organic based thixotropic additives may also be used provided that their molecular weight is low enough that they do not form effective films which interfere with the haze values obtained in the coating. A Molecular weight of less 1000 is preferred and less than 500 is most preferred. Examples of organic based thixotropic additives include but are not limited to: hydrogenated castor oils, hydrogenated castor oil waxes, inorganically modified castor oils, organically modified castor oils such as those sold by Elementis Specialties under the Thixcin® trademark, triglycerides such as glyceryl tri-12-hydroxy stearate, polyamides and modified polyamides such as 12-hydroxystearic acid diamide of ethylene diamine, 12-hydroxystearic acid diglycolamide, N-stearyl ricinoleamide, N-stearyl stear-

amide and other polyamide waxes. Included in these polyamide materials are those sold commercially by Kusumoto Chemicals Industries under the Disparlon® trademark, by Lehmann and Voss under the Luvotix® trademark, by Elementis Specialties under the Thixatrol® trademark, polyethylene oxide waxes, urea urethanes believed to be exemplified by those sold by Byk Incorporated as, for example, by Byk-410, Byk-411, and Byk-420, acrylic resins, amine salts of polymeric polyesters, salts of linear polyaminoamide and polymeric polyester, alkyl sulfonate, alkylallyl sulfonate, colloidal ester, polyester resin such as those sold by Elementis Specialties under the Thixatrol® trademark, phenol resin, melamine resin, epoxy resin, urethane resin, styrene butadiene polymers, polyimide resin, and polyester amides. Materials such as those sold by Byk under the trademarks of Anti-Terra® and Bykumen® can also be used.

EXAMPLES

[0037] The following examples are presented to describe to the skilled artisan a few embodiments of the invention.

[0038] While the examples below are applied to a Colorpop, the same results were obtained when the laminate coatings were applied using color wheels such as those used for standard testing of nail coatings and on natural nails.

Example 1—Preparation of Laminate according to the Invention

[0039] To a Colorpop artificial nail available from Colorpops International was applied with a nail brush the formula given in Table 1 which can be used for base or top coats. The coating was cured for 2 minutes using a UV light designed for curing nail coatings and the tacky layer was removed by wiping with isopropanol. A layer of Shlenk Decomet 3014/10 aluminum platelets which had been diluted with butyl acetate to a 2% platelet level was then applied with a nail brush and the layer was allowed to dry for 30 seconds. A second layer of the formulation in Table 1 then applied and cured for 2 minutes using the same UV light followed by removal of the tacky layer with isopropanol. The resulting coating gave a superior mirror finish when compared to the laminate of Example 3.

TABLE 1

Material	Wt %
Unsaturated Oligomer ¹	69.19%
Trimethyl propane triacrylate	13.42%
Hydroxy ethyl methacrylate	13.37%
TPO ²	4.02%

¹Urethane acrylate oligomer available from Sartomer Division of Arkema

²Diphenyl-(2,4,6-trimethylbenzoyl) phosphine oxide

Example 2 (Invention)

[0040] The same procedure as used in Example 1 was used with the exception that the platelet dispersion contained 0.05% of Byk 410, a urea based thixotropic thickener. The resulting coating gave a superior mirror finish to the laminate of Example 3.

Example 3—Comparative

[0041] The same procedure as used in Example 1 was used with the exception that the platelet dispersion contained the following formulation given in Table 2.

TABLE 2

Material	Wt %
Decomet	4.08%
3104/10*	
Butyl Acetate	32.10%
Ethyl Acetate	51.2%
Isopropyl	1.89%
Alcohol	
Ethyl Alcohol	5.53%
Dimethicone	0.01%
Nitrocellulose	4.38%
$\frac{5}{8}$ sec	
Camphor	0.8%

*As supplied - 10% dispersion in Ethyl Acetate

[0042] The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned, as well as others inherent therein. While the invention has been depicted and described and is defined by reference to particular preferred embodiments of the invention, such references do not imply a limitation on the invention, and no such limitation is to be inferred. The invention is capable of considerable modification, alteration and equivalents in form and function, as will occur to those ordinarily skilled in the pertinent arts. The depicted and described preferred embodiments of the invention are exemplary only and are not exhaustive of the scope of the invention. Consequently, the invention is intended to be limited only by the spirit and scope of the appended claims, giving full cognizance to equivalents in all respects.

What is claimed is:

1. A multi-layer cosmetic laminate for decorating natural or artificial human nails comprised of at least three layers, a UV cured coating as the first layer, a layer comprising aluminum platelets as the second layer, and another UV cured coating layer as the third layer, the second layer which comprises aluminum platelets being substantially free of film former.

2. The laminate of claim 1 comprised of one or more layers in addition to the first, second, and third layers, the one or more layers in addition being one or more enamel layers and/or one or more UV cured gel coat layers.

3. The laminate of claim 1 having a haze value greater than 950 HU.

4. The laminate of claim 1 wherein the UV cured coating layers are each formed by curing under UV radiation a composition comprising one or more ethylenically unsaturated monomers, one or more ethylenically unsaturated oligomers, or mixtures said ethylenically unsaturated monomer or monomers and said ethylenically unsaturated oligomer or oligomers, and a photoinitiator.

5. The laminate of claim 4 wherein monomers and/or oligomers are selected from mono-, di-, tri-, and tetra-functional ethylenically unsaturated monomers and/or oligomers.

6. The laminate of claim 4 wherein monomers and/or oligomers are (meth)acrylic.

7. The laminate of claim 4 wherein comprising oligomers which are aliphatic polyester based urethane diacrylate oligomers.

8. The laminate of claim 1 wherein the second layer comprising aluminum platelets is formed subsequent to curing the first base coat layer by coating the cured first base coat layer with a suspension of aluminum platelets in solvent and then evaporating the solvent to form a dry coating of aluminum.

9. The laminate of claim 8 wherein the solvent is selected from the group consisting of ethyl acetate, butyl acetate, acetone, and mixtures thereof.

10. The laminate of claim 1 wherein the third layer is free of pigment.

11. The laminate of claim 1 wherein a fourth layer is coated on top of the three layer laminate.

12. The laminate of claim 1 wherein second layer comprises a leafing agent.

13. The laminate of claim 1 wherein second layer comprises a leafing agent comprising a long chain phosphoric acid ester.

14. The laminate of claim 1 wherein aluminum platelets of the second layer are made by a method which comprises physical vapor deposition.

15. The laminate of claim 1 wherein aluminum platelets are multi-layered effect pigments created by physical vapor deposition having an aluminum core with MgF2 layers deposited thereon and a grating with a defined spacing between grating structures embossed on these low refracting layers which produces a prismatic rainbow-like diffraction effect when observed under visible light.

16. A method of decorating natural or artificial human nails comprising

- a) applying a first layer comprising a UV curable gel coating composition comprising one or more ethylenically unsaturated monomers, one or more ethylenically unsaturated oligomers, or mixtures of said ethylenically unsaturated monomer or monomers and said ethylenically unsaturated oligomer or oligomers, and a photoinitiator;
- b) curing the first layer under UV radiation;
- c) applying a second layer comprising aluminum platelets which is substantially free of film former;
- d) applying a third layer comprising the UV curable gel coating composition; and
- e) curing the third layer under UV radiation.

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