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(54) **METHODS AND COMPOSITIONS FOR READILY REMOVING NAIL COATINGS**

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**ABSTRACT**

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A method and kit for treating a nail surface. The method includes brushing or spraying an adhesive on a coated or uncoated nail surface to form an adhesive-coated surface. A covering (e.g., a curable nail gel, evaporative nail polish, or artificial nail) is then applied to the adhesive-coated surface. The covering is removable by soaking in solvent for less than 20 minutes, peeling, or a combination thereof.

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## METHODS AND COMPOSITIONS FOR READILY REMOVING NAIL COATINGS

### TECHNICAL FIELD

[0001] This invention relates to removing nail coatings, e.g., curable gel coatings or evaporative polishes, from coated and uncoated nail surfaces.

### BACKGROUND

[0002] Both evaporative nail polishes and curable gel coatings have been used to coat natural and artificial nails, including nail extensions. The evaporative polishes can be water-borne or in the form of a solution with an organic solvent. Following application, the coating is dried to remove solvent. Drying times can be as long as an hour or more, depending on the number of coats applied. The dried coating is typically treated with a solvent such as acetone when it is desired to change or remove the polish.

[0003] The gel compositions typically include acrylic or methacrylic monomers and oligomers. Once cured following application, e.g., by exposure to ultraviolet or visible radiation, or by thermal or redox methods, the gels form a hard, durable coating in a relatively short period of time on the order of minutes. Removing the cured coating, however, is more difficult than removing an evaporative polish. Typically it is necessary to soak the coated nail with solvent such as acetone, ethyl acetate, amyl acetate, ethanol, butanol, or the like for a period of time, with the aid of a cotton ball or nail wipe covered with foil, or by soaking in a bowl of solvent, after which the cured gel coating is removed.

### SUMMARY

[0004] In one aspect, there is described a method for treating a nail surface that includes brushing or spraying an adhesive on a coated or uncoated nail surface to form an adhesive-coated surface. For example, the adhesive may be applied by dipping a brush in a container holding the adhesive and then using the brush to spread the adhesive on the nail surface. Alternatively, the adhesive may be squeezed onto the nail surface and then manipulated, e.g., using a brush so that it covers the desired area of the nail surface. A covering (e.g., a curable nail gel, evaporative nail polish, or artificial nail) is then applied to the adhesive-coated surface. The covering is removable by soaking in solvent for less than 20 minutes, peeling, or a combination thereof.

[0005] The adhesive may be applied to the entire nail surface or to a portion of the nail surface. In some embodiments, the covering is removable by soaking in solvent for less than 20 minutes or less than 10 minutes. In other embodiments, the coating is removable by peeling it from the adhesive.

[0006] The adhesive may be a solvent-based or aqueous-based adhesive. In some embodiments, it is formed in situ following application to the nail surface. Examples of suitable adhesives include (meth)acrylates, silicones, polyvinyl acetates, polyethylene vinyl acetates, polyisoprene rubbers, styrene-methacrylate copolymers, styrene-butadiene rubbers, methacrylate-butadiene-styrene copolymers, and combinations thereof. In one embodiment, the adhesive is a crosslinked (meth)acrylate copolymer. An example of such an adhesive is the polymerization product of (a) a  $C_1$ - $C_{20}$  alkyl methacrylate monomer (e.g., butyl methacrylate); (b) a  $C_1$ - $C_{20}$  alkyl acrylate monomer (e.g., butyl acrylate), and

(c) an ethylenically unsaturated (meth)acrylate crosslinking monomer (e.g., an alkylene glycol dimethacrylate). Uncrosslinked adhesives may be used as well. The adhesive may also include mixtures of different types of adhesives. For example, in some embodiments, e.g., for use with artificial nails or nail tips, the adhesive may be blended with, e.g., a cyanoacrylate adhesive to assist in adhering the artificial nail or nail tip to the underlying nail surface. The amount of the second adhesive is selected such that it does not compromise removability.

[0007] The nail covering may be a curable gel coating (e.g., a base coat, color coat, or top coat), an evaporative nail polish, a reactive nail polish, an artificial nail or nail tip, or nail art. The artificial nail or nail tip, in turn, may be adhered to the adhesive-coated surface via a second adhesive such as a cyanoacrylate adhesive. The nail covering may be in the form of a continuous coating. Alternatively, it may be discontinuous. An example of the latter is a decal or decorative design.

[0008] In some embodiments, the adhesive is applied to an uncoated nail surface. In other embodiments, the nail surface is a coated nail surface. For example, the nail surface may be coated with a cured nail gel (e.g., a base coat or color coat).

[0009] Also described is a kit that includes (a) a brushable or sprayable adhesive suitable for application to a coated or uncoated nail surface; and (b) a nail covering selected from the group consisting of radiation-curable nail gels, evaporative nail polishes, artificial nails, and combinations thereof. When the adhesive is applied to a coated or uncoated nail surface, followed by application of the nail covering, the nail covering is removable by soaking in solvent for less than 20 minutes, peeling, or a combination thereof.

[0010] In another aspect, the nail covering may be combined with the adhesive. Accordingly, there is described a method for treating a nail surface that includes (a) providing a composition comprising (i) an adhesive and (ii) a nail covering selected from the group consisting curable gels, evaporative nail polishes, reactive nail polishes, and combinations thereof; and (b) applying the composition to a coated or uncoated nail surface by brushing or spraying. Following application, the nail covering is removable by soaking in solvent for less than 20 minutes, peeling, or a combination thereof.

[0011] The adhesive or adhesive/nail covering combination composition is applied to both coated and uncoated nail surfaces by simply brushing or spraying it on the surface. Therefore, it is easy for nail technicians for apply, unlike adhesive films, which must be positioned at a particular location on the nail surface. When it is desired to remove the nail covering, e.g., to change the color or type of covering, the covering is easily removed from the adhesive-coated surface by soaking for a limited amount of time or by simply peeling it off. Because the covering is easily removed, damage to the underlying nail surface is minimized.

[0012] The details of one or more embodiments of the invention are set forth in the description below. Other features, objects, and advantages of the invention will be apparent from the description and from the claims.

### DETAILED DESCRIPTION

[0013] A solvent-based adhesive is brushed or sprayed on a coated or uncoated nail surface. The adhesive may be

pre-polymerized. Alternatively, the adhesive may be polymerized in situ following application to the coated or uncoated nail surface. Once dried, the adhesive forms a tacky surface to which a nail covering may be adhered. Alternatively, the nail covering (gel coating, evaporative nail polish, reactive nail polish, or combination thereof) may be combined with the adhesive and the resulting composition applied to the coated or uncoated nail surface. The use of the adhesive makes it possible to remove the nail covering simply by peeling or by soaking for a relatively short period of time without damaging the underlying nail. In particular, when the nail covering is soaked off according to the protocol described in U.S. Pat. No. 6,803,394, which is incorporated by reference, using a soak-off agent selected from the group consisting of acetone, ethyl acetate, amyl acetate, ethanol, and butanol, the nail covering soaks off in 20 minutes or less.

**[0014]** In some embodiments, the adhesives are lightly crosslinked and engineered such that they fail cohesively when the nail covering is peeled off. This results in some adhesive remaining on the nail surface, which protects the nail surface from damage. Suitable adhesives include (meth)acrylates, silicones, polyvinyl acetates, polyethylene vinyl acetates, polyisoprene rubbers, styrene-methacrylate copolymers, styrene-butadiene rubbers, methacrylate-butadiene-styrene copolymers, and combinations thereof. In other embodiments, the adhesives are designed to fail adhesively.

**[0015]** Crosslinked (meth)acrylate copolymers have been found to be particularly useful. An example of such an adhesive is the polymerization product of (a) a  $C_1$ - $C_{20}$  alkyl methacrylate monomer; (b) a  $C_1$ - $C_{20}$  alkyl acrylate monomer, and (c) an ethylenically unsaturated (meth)acrylate crosslinking monomer (e.g., an alkylene glycol dimethacrylate). In some embodiments, the adhesive may also incorporate acrylic acid to improve cohesive strength.

**[0016]** Examples of suitable (meth)acrylate monomer include 2-hydroxyethyl (meth)acrylate/succinate adduct, acetoacetoxy (meth)acrylate, acetoacetoxy ethyl (meth)acrylate (AAEMA, AAEA), butyl (meth)acrylate, cyclohexyl (meth)acrylate, ethyl (meth)acrylate (EMA, EA), glycidyl (meth)acrylates, hexyl (meth)acrylate, hydroxyethyl (meth)acrylate (HEMA, HEA), hydroxyethyl (meth)acrylate acetate, hydroxypropyl (meth)acrylate (HPMA, HPA), isobutyl (meth)acrylate, lauryl (meth)acrylate, maleic anhydride, methoxy polyethylene glycol (350) mono(meth)acrylate, mono or poly (meth)acrylic acids, phthalic acid monoethyl (meth)acrylate, polybutylene glycol (meth)acrylates, polyethylene glycol (600) mono(meth)acrylate, polyethylene glycol (meth)acrylates, polypropylene glycol (meth)acrylates, PPG mono(meth)acrylate, stearyl (meth)acrylate, tetrahydrofurfuryl (meth)acrylate (THFMA, THFA), tridecyl (meth)acrylate, and urethane (meth)acrylate.

**[0017]** Examples of suitable crosslinking monomers include 1,3-glycerol di(meth)acrylate/succinate adduct, 2-hydroxyethyl di(meth)acrylate/succinate adduct, ethylene glycol di(meth)acrylate, glycidyl (meth)acrylate, isopropylidenediphenyl bisglycidyl (meth)acrylate, methacroyloxyethyl maleate, neopentylglycol di(meth)acrylate, organosilanes, organotitanates, PEG-4 di(meth)acrylate, propoxylated allyl (meth)acrylate, pyromellitic di(meth)acrylate, pyromellitic dianhydride di(meth)acrylate, pyromellitic dianhydride glyceryl di(meth)acrylate (PMGDM, PMGD), tetraethylene glycol di(meth)acrylate, triethylene glycol di(meth)acrylate, and trimethylolpropane tri(meth)acrylate.

**[0018]** The adhesive may be applied to an uncoated (i.e. bare) nail surface to permit removal of subsequent coverings from the adhesive-coated nail surface. Alternatively, the adhesive may be applied to a coated nail surface, e.g., a nail surface coated with a base coat or color coat.

**[0019]** A number of different nail coverings may be applied to the adhesive-coated nail surface. In some embodiments, an evaporative nail polish may be applied to the adhesive-coated surface. Such polishes form a film when the solvent evaporates. The evaporative nail polishes may be solvent or water-based. Reactive nail polishes are also useful as nail coverings. Such polishes include reactive monomers that polymerize, e.g., by exposure to heat following application. Examples of suitable reactive nail polishes are commercially available and include, e.g., Orly Epix Nail Polish (Los Angeles, Calif.). Artificial nails or nail extensions may also be applied to the adhesive-coated surface. Commercially available examples include H&C Nail Extensions (Korea). Nail art may be used as well.

**[0020]** The adhesive-coated surfaces are particularly useful with curable nail gel coverings, e.g., base coats, color coats, and top coats, because such coverings are typically difficult to remove. Examples of suitable curable nail gels are described in U.S. Pat. No. 8,697,619, which is hereby incorporated by reference in its entirety.

## EXAMPLES

### Adhesive Synthesis

**[0021]** The following procedure describes the preparation of a representative crosslinked (meth)acrylate adhesive (butyl acrylate/butyl methacrylate/1,3 butylene glycol dimethacrylate).

**[0022]** To a 500 mL resin flask equipped with a condenser, nitrogen inlet, mechanical stirrer with a Teflon half-moon blade, and a heating mantle was added 170.7 g methyl ethyl ketone. The equipment was placed under a gentle flow of nitrogen, water started through the condenser, and agitation was started at 225 rpm. The solvent was then heated to 78-79° C. and held. To the hot solvent was added a solution of 55.0 g butyl acrylate, 40.0 g butyl methacrylate, 5.0 g 1,3-butylene glycol dimethacrylate, 1.0 g VAZO 52 (2,2'-azobis(2,4-dimethylvaleronitrile), and 10.0 g methyl ethyl ketone over 2 h. The temperature of the reaction solution was allowed to rise to 80-82° C. during the addition. After the addition was complete, the reaction solution was held at 80-82° C. for 30 min. A solution of 0.5 g VAZO 52 and 5.0 g methyl ethyl ketone was then added to the hot reaction solution in a single portion. The reaction solution was then held at 80-82° C. for 40 min after which it was cooled to not more than 35° C. and packaged.

### Adhesive Peel Test

**[0023]** Adhesive peel strength was evaluated using the following test method.

**[0024]** On a 8<sup>15</sup>/<sub>16</sub> inch×5<sup>14</sup>/<sub>16</sub> inch×¼ inch clean glass plate, three thin strips of each adhesive sample were placed approximately 1.5 inches apart. A 1.5 ml adhesive solution was used for each sample. Using an applicator brush, each sample was gently brushed out to fill an approximately 1 inch×3 inch area, after which solvent was allowed to evaporate for 5 minutes.

**[0025]** Each dried adhesive strip was coated with gel nail polish, leaving a 0.25 inch border beyond the adhesive border along the sides and bottom, and a 0.5 inch border beyond the top. Metal hooks were placed on the top border and pressed gently to submerge them into gel coating. The hooks were thin pieces of metal about 2 inch×1 inch bent to approximately 90° perpendicular to the main axis. Each hook had a small hole centered toward the top. 2 mL gel polish was placed on the surface of each hook or until they are completely sealed into the gel. The gel polish was cured by exposure to ultraviolet light for 3 minutes.

**[0026]** A fishing scale was secured to a three finger clamp, which in turn was secured to a ring stand such that the scale's hook was positioned one foot above the surface of the bench. The cured film directly underneath the metal hooks was gently loosened, by prying. The entire sample system (glass plate, hooks, etc.) was then placed on a lab jack and secured to the jack platform using binder clips. The lab jack platform was raised until the scale could be connected to a metal hook and positioned so the scale was being initially pulled directly downward. The lab jack was then lowered about 3.5 inches over about 10-15 seconds at a constant rate while observing the scale readout. The maximum readout of the fishing scale was recorded during this process. The process was then repeated for the other two strips and the mean of the three trials reported.

**[0027]** The peel force to remove the cured gel polish was measured for a number of different adhesives. The results are shown in Table 1.

TABLE 1

Example	Composition	Peel Force (kg)
1	58.2 BA/30.9 BMA/8.4 BGDMA/2.5 NVP	3.01
2	56.5 BA/30 BMA/8.4 BGDMA/5 NVP	3.24
3	58.2 BA/30.9 BMA/8.4 BGDMA/2.5 HEA	2.76
4	56.5 BA/30 BMA/8.4 BGDMA/5 HEA	3.85
5	58.2 BA/30.9 BMA/8.4 BGDMA/2.5 AA	2.77
6	56.5 BA/30 BMA/8.4 BGDMA/5 AA	3.12
7	69.2 BA/22.4 MMA/8.4 BGDMA	2.49
8	59.8 BA/10.0 MMA/8.4 BGDMA	1.58
9	81.6 BA/31.8 BMA/8.4 BGDMA	1.24
10	72.3 BA/19.3 MA/8.4 BGDMA	1.35
11	69 BA/20 BMA/11 BGDMA	2.30
12	59.8 BA/31.8 BMA/8.4 BGDMA	2.83
13	68.3 BA/26.6 BMA/5 BGDMA	0.56
14	55 BA/40 BMA/5 BGDMA	2.49
15	69 BA/20 BMA/11 BGDMA	1.69
16	50 BA/39 BMA/11 BGDMA	0.87
17	75 BA/20 BMA/5 BGDMA	0.73
18	95 BA/4 BMA/1 BGDMA	0.28
19	89.25 BA/10 BMA/0.75 BGDMA	0.32
20	97 BA/2.15 BMA/0.875 BGDMA	0.27
21	88.75 BA/10 BMA/1.25 BGDMA	0.29
22	92.1 BA/7.025 BMA/0.8751 BGDMA	0.26
23	88.75 BA/10 BMA/1.25 BGDMA	0.21
24	98.75 BA/0 BMA/1.25 BGDMA	0.25
25	53.5 BA/44 LMA/2.5 ALMA	0.53
26	88.2 BA/10 LMA/1.83 ALMA	0.32
27	62.75 BA/35.5 LMA/1.75 ALMA	0.82
28	76.2 BA/21.3 LMA/2.5 ALMA	0.24
29	71 BA/27 LMA/2 ALMA	0.34
30	54.5 BA/44 LMA/1.5 ALMA	0.91
31	88.2 BA/10 LMA/1.83 ALMA	0.28
32	37.5 BA/42.9 LMA/0.616 AA/1.5 ALMA/17.4 BMA	0.26
33	22.5 BA/25 LMA/0AA/1.5 ALMA/51 BMA	0.87
34	22.5 BA/25 LMA/1 AA/0.5 ALMA/51 BMA	0.69

TABLE 1-continued

Example	Composition	Peel Force (kg)
35	22.5 BA/25 LMA/0 AA/1.5 ALMA/51 BMA	0.62
36	22.5 BA/75 LMA/1 AA/1.5 ALMA	0.13
37	50 BA/49.5 LMA/0 AA/0.5 ALMA	0.16
38	22.5 BA/75 LMA/1AA/1.5 ALMA	0.25
39	22.5 BA/59.8 LMA/0 AA/0.5 ALMA/17.2 BMA	0.07
40	50 BA/49.5 LMA/0 AA/0.5 ALMA	0.08
41	50 BA/25 LMA/1 AA/1.5 ALMA/22.5 BMA	0.26
42	22.5 BA/41.0 LMA/1 AA/1 ALMA/34.5 BMA	0.70
43	polyvinylacetate copolymer in water <sup>1</sup>	0.20
44	Styrene-(Meth)acrylate copolymer <sup>2</sup>	0.57
45	Styrene-Butadiene (SBR) copolymer <sup>3</sup>	1.60
46	(Meth)acrylate-Butadiene-Styrene (MBS) copolymer <sup>4</sup>	3.33
47	natural rubber (polyisoprene) <sup>5</sup>	0.74
48	Polydimethylsiloxane polymer <sup>6</sup>	0.50
49	Copal resin <sup>7</sup>	0.28
50	55.0 BA/40.0 BMA/5.0 BGDMA <sup>8</sup>	8.71

<sup>1</sup>Elmer's Glue (Elmer's Products, OH)

<sup>2</sup>Aleene's Fabric Fusion (iLoveToCreate, CA)

<sup>3</sup>Shoe Goo (Eclectic Products, LA)

<sup>4</sup>Spray Bond (Elmer's Products, OH)

<sup>5</sup>Rubber Cement (Elmer's Products, OH)

<sup>6</sup>DAP Sealant (DAP, MD)

<sup>7</sup>Spirit Gum (Spirit Halloween, NJ)

<sup>8</sup>Polymerized in situ on glass surface.

BA = Butyl Acrylate

LMA = Lauryl Methacrylate

BMA = Butyl Methacrylate

AA = Acrylic Acid

ALMA = Allyl Methacrylate

BGDMA = Butylene Glycol Dimethacrylate

HEA = Hydroxyethyl acrylate

NVP = N-vinyl pyrrolidone

**[0028]** A number of embodiments of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A method for treating a nail surface comprising:

(a) brushing or spraying an adhesive on a coated or uncoated nail surface; and

(b) applying a covering to the adhesive-coated surface, wherein following application the covering is removable by soaking in solvent for less than 20 minutes, peeling, or a combination thereof.

2. The method of claim 1 wherein the adhesive is applied to the entire nail surface.

3. The method of claim 1 wherein the adhesive is applied to a portion of the nail surface.

4. The method of claim 1 wherein the covering is removable by soaking in solvent for less than 20 minutes.

5. The method of claim 1 wherein the covering is removable by soaking in solvent for less than 10 minutes.

6. The method of claim 1 wherein the covering is removable by peeling.

7. The method of claim 1 wherein the adhesive is a solvent-based adhesive.

8. The method of claim 1 wherein the adhesive is formed in situ upon application to the nail surface.

9. The method of claim 1 wherein the adhesive is selected from the group consisting of (meth)acrylates, silicones, polyvinyl acetates, polyethylene vinyl acetates, polyiso-

prene rubbers, styrene-methacrylate copolymers, styrene-butadiene rubbers, methacrylate-butadiene-styrene copolymers, and combinations thereof.

**10.** The method of claim **1** wherein the adhesive comprises a crosslinked (meth)acrylate copolymer.

**11.** The method of claim **10** wherein the adhesive is the polymerization product of (a) a C<sub>1</sub>-C<sub>20</sub> alkyl methacrylate monomer; (b) a C<sub>1</sub>-C<sub>20</sub> alkyl acrylate monomer; and (c) an ethylenically unsaturated (meth)acrylate crosslinking monomer.

**12.** The method of claim **11** wherein the alkyl methacrylate monomer is butyl methacrylate, the alkyl acrylate monomer is butyl acrylate, and the crosslinking monomer is an alkylene glycol dimethacrylate.

**13.** The method of claim **1** wherein the nail covering comprises a curable gel coating selected from the group consisting of base coats, color coats, and top coats.

**14.** The method of claim **1** wherein the nail covering comprises an evaporative nail polish.

**15.** The method of claim **1** wherein the nail covering comprises an artificial nail or nail tip.

**16.** The method of claim **1** wherein the nail covering comprises a reactive nail polish.

**17.** The method of claim **1** wherein the nail surface is an uncoated nail surface.

**18.** The method of claim **1** wherein the nail surface is coated with a cured nail gel.

**19.** A method for treating a nail surface comprising:

- (a) brushing or spraying an adhesive on a coated or uncoated nail surface, wherein the adhesive is the polymerization product of (a) a C<sub>1</sub>-C<sub>20</sub> alkyl methacry-

late monomer; (b) a C<sub>1</sub>-C<sub>20</sub> alkyl acrylate monomer; and (c) an ethylenically unsaturated (meth)acrylate crosslinking monomer; and

- (b) applying a curable gel covering to the adhesive-coated surface,

wherein following application the covering is removable by soaking in solvent for less than 10 minutes, peeling, or a combination thereof.

**20.** A method for treating a nail surface comprising:

- (a) providing a composition comprising (a) an adhesive and (b) a nail coating selected from the group consisting of curable gels, evaporative nail polishes, reactive nail polishes, and combinations thereof; and

- (b) brushing or spraying the composition on a coated or uncoated nail surface,

wherein following application the nail coating is removable by soaking in solvent for less than 20 minutes, peeling, or a combination thereof.

**21.** A kit comprising:

- (a) a brushable or sprayable adhesive suitable for application to a coated or uncoated nail surface; and

- (b) a nail covering selected from the group consisting of curable nail gels, evaporative nail polishes, reactive nail polishes, artificial nails, and combinations thereof, wherein when the adhesive is applied to a coated or uncoated nail, followed by application of the nail covering, the nail covering is removable by soaking in solvent for less than 20 minutes, peeling, or a combination thereof.

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