

CLAIMS

What is claimed is:

1. A method for delaminating a composite by immersing the composite into a delamination solution; wherein the composite comprises a substrate and a coating applied on one side or both sides of the substrate comprising a polymeric binder; and wherein the polymeric binder comprises a copolymer comprising a structural unit derived from an acid group-containing monomer.
2. The method of claim 1, wherein the copolymer further comprises a structural unit derived from a hydrogen bond-forming group-containing monomer that is selected from the group consisting of a nitrile group-containing monomer, an amide group-containing monomer, a hydroxyl group-containing monomer, an ester group-containing monomer, an epoxy group-containing monomer, a fluorine-containing monomer or combinations thereof.
3. The method of claim 2, wherein the proportion of structural unit derived from a hydrogen bond-forming group-containing monomer is from about 5% to about 85% by mole, based on the total number moles of monomeric units in the copolymer in the polymeric binder.
4. The method of claim 1, wherein the substrate is in the form of a foil, sheet, film or a combination thereof; wherein the substrate is selected from the group consisting of stainless steel, titanium, nickel, aluminum, copper, platinum, gold, silver, chromium, zirconium, tungsten, molybdenum, silicon, tin, vanadium, zinc, cadmium, or alloys thereof, electrically-conductive resin or combinations thereof; and wherein the substrate has a two-layered structure comprising an outer layer and an inner layer, wherein the outer layer comprises a conductive material and the inner layer comprises an insulating material or another conductive material.
5. The method of claim 4, wherein the conductive material is selected from the group consisting of stainless steel, titanium, nickel, aluminum, copper, platinum, gold, silver, chromium, zirconium, tungsten, molybdenum, silicon, tin, vanadium, zinc, cadmium, or alloys thereof, electrically-conductive resin or combinations thereof; and wherein the insulating material is a polymeric material selected from the group consisting of polycarbonate, polyacrylate, polyacrylonitrile, polyester, polyamide, polystyrene, polyurethane, polyepoxy, poly(acrylonitrile butadiene styrene), polyimide, polyolefin, polyethylene, polypropylene, polyphenylene sulfide, poly(vinyl ester), polyvinyl chloride, polyether, polyphenylene oxide, cellulose polymer and combinations thereof.
6. The method of claim 1, wherein the acid group-containing monomer is selected from the group consisting of a carboxylic acid group-containing monomer, a sulfonic acid group-containing monomer, a phosphonic acid group-containing monomer or combinations thereof.
7. The method of claim 6, wherein the carboxylic acid group-containing monomer is

selected from the group consisting of acrylic acid, methacrylic acid, crotonic acid, 2-butyl crotonic acid, cinnamic acid, maleic acid, maleic anhydride, fumaric acid, itaconic acid, itaconic anhydride, tetraconic acid, 2-ethylacrylic acid, isocrotonic acid, cis-2-pentenoic acid, trans-2-pentenoic acid, angelic acid, tiglic acid, 3,3-dimethyl acrylic acid, 3-propyl acrylic acid, trans-2-methyl-3-ethyl acrylic acid, cis-2-methyl-3-ethyl acrylic acid, 3-isopropyl acrylic acid, trans-3-methyl-3-ethyl acrylic acid, cis-3-methyl-3-ethyl acrylic acid, 2-isopropyl acrylic acid, trimethyl acrylic acid, 2-methyl-3,3-diethyl acrylic acid, 3-butyl acrylic acid, 2-butyl acrylic acid, 2-pentyl acrylic acid, 2-methyl-2-hexenoic acid, trans-3-methyl-2-hexenoic acid, 3-methyl-3-propyl acrylic acid, 2-ethyl-3-propyl acrylic acid, 2,3-diethyl acrylic acid, 3,3-diethyl acrylic acid, 3-methyl-3-hexyl acrylic acid, 3-methyl-3-tert-butyl acrylic acid, 2-methyl-3-pentyl acrylic acid, 3-methyl-3-pentyl acrylic acid, 4-methyl-2-hexenoic acid, 4-ethyl-2-hexenoic acid, 3-methyl-2-ethyl-2-hexenoic acid, 3-tert-butyl acrylic acid, 2,3-dimethyl-3-ethyl acrylic acid, 3,3-dimethyl-2-ethyl acrylic acid, 3-methyl-3-isopropyl acrylic acid, 2-methyl-3-isopropyl acrylic acid, trans-2-octenoic acid, cis-2-octenoic acid, trans-2-decenoic acid, α -acetoxyacrylic acid, β -trans-aryloxyacrylic acid, α -chloro- β -E-methoxyacrylic acid, methyl maleic acid, dimethyl maleic acid, phenyl maleic acid, bromo maleic acid, chloromaleic acid, dichloromaleic acid, fluoromaleic acid, difluoro maleic acid, nonyl hydrogen maleate, decyl hydrogen maleate, dodecyl hydrogen maleate, octadecyl hydrogen maleate, fluoroalkyl hydrogen maleate, maleic anhydride, methyl maleic anhydride, dimethyl maleic anhydride, acrylic anhydride, methacrylic anhydride, methacrolein, methacryloyl chloride, methacryloyl fluoride, methacryloyl bromide and combinations thereof.

8. The method of claim 6, wherein the sulfonic acid group-containing monomer is selected from the group consisting of vinylsulfonic acid, methylvinylsulfonic acid, allylvinylsulfonic acid, allylsulfonic acid, methallylsulfonic acid, styrenesulfonic acid, 2-sulfoethyl methacrylic acid, 2-methylprop-2-ene-1-sulfonic acid, 2-acrylamido-2-methyl-1-propane sulfonic acid, 3-allyloxy-2-hydroxy-1-propane sulfonic acid and combinations thereof.

9. The method of claim 6, wherein the phosphonic acid group-containing monomer is selected from the group consisting of vinyl phosphonic acid, allyl phosphonic acid, vinyl benzyl phosphonic acid, acrylamide alkyl phosphonic acid, methacrylamide alkyl phosphonic acid, acrylamide alkyl diphosphonic acid, acryloylphosphonic acid, 2-methacryloyloxyethyl phosphonic acid, bis(2-methacryloyloxyethyl) phosphonic acid, ethylene 2-methacryloyloxyethyl phosphonic acid, ethyl-methacryloyloxyethyl phosphonic acid and combinations thereof.

10. The method of claim 1, wherein the proportion of structural unit derived from an acid group-containing monomer is from about 15% to about 85% by mole, based on the total number moles of monomeric units in the copolymer in the polymeric binder.

11. The method of claim 1, wherein the copolymer further comprises a structural unit derived from a nitrile group-containing monomer and a structural unit derived from an amide group-containing monomer.

12. The method of claim 11, wherein the nitrile group-containing monomer is selected from the group consisting of acrylonitrile, α -halogenoacrylonitrile, α -alkylacrylonitrile, α -chloroacrylonitrile, α -bromoacrylonitrile, α -fluoroacrylonitrile, methacrylonitrile, α -ethylacrylonitrile, α -isopropylacrylonitrile, α -n-hexylacrylonitrile, α -methoxyacrylonitrile, 3-methoxyacrylonitrile, 3-ethoxyacrylonitrile, α -acetoxyacrylonitrile, α -phenylacrylonitrile, α -tolylacrylonitrile, α -(methoxyphenyl)acrylonitrile, α -(chlorophenyl)acrylonitrile, α -(cyanophenyl)acrylonitrile, vinylidene cyanide and combinations thereof; and wherein the proportion of structural unit derived from a nitrile group-containing monomer is from about 15% to about 85% by mole, based on the total number moles of monomeric units in the copolymer in the polymeric binder.

13. The method of claim 11, wherein the amide group-containing monomer is selected from the group consisting of acrylamide, methacrylamide, N-methyl methacrylamide, N-ethyl methacrylamide, N-n-propyl methacrylamide, N-isopropyl methacrylamide, isopropyl acrylamide, N-n-butyl methacrylamide, N-isobutyl methacrylamide, N,N-dimethyl acrylamide, N,N-dimethyl methacrylamide, N,N-diethyl acrylamide, N,N-diethyl methacrylamide, N-methylol methacrylamide, N-(methoxymethyl)methacrylamide, N-(ethoxymethyl)methacrylamide, N-(propoxymethyl)methacrylamide, N-(butoxymethyl)methacrylamide, N,N-dimethyl methacrylamide, N,N-dimethylaminopropyl methacrylamide, N,N-dimethylaminoethyl methacrylamide, N,N-dimethylol methacrylamide, diacetone methacrylamide, diacetone acrylamide, methacryloyl morpholine, N-hydroxyl methacrylamide, N-methoxymethyl acrylamide, N-methoxymethyl methacrylamide, N,N'-methylene-bis-acrylamide (MBA), N-hydroxymethyl acrylamide and combinations thereof; and wherein the proportion of structural unit derived from an amide group-containing monomer is from about 0% to about 35% by mole, based on the total number of moles of monomeric units in the copolymer in the polymeric binder.

14. The method of claim 1, wherein the delamination solution comprises a delamination agent and an aqueous solvent.

15. The method of claim 14, wherein the delamination agent is selected from the group consisting of formic acid, acetic acid, glycolic acid, glyoxylic acid, oxalic acid, propionic acid, acrylic acid, propiolic acid, lactic acid, 3-hydroxipropionic acid, glyceric acid, pyruvic acid, 3-oxopropionic acid, 2,3-dioxopropionic acid, malonic acid, tartronic acid, dihydroxymalonic acid, mesoxalic acid, glycidic acid, butyric acid, isobutyric acid, crotonic acid, isocrotonic acid, methacrylic acid, vinylacetic acid, tetrollic acid, 2-hydroxybutyric acid, 3-hydroxybutyric acid, 4-hydroxybutyric acid, 2-oxobutanoic acid, acetoacetic acid, 4-oxobutanoic acid, butanedioic acid, methylmalonic acid, fumaric acid, maleic acid, 2-hydroxybutanedioic acid, tartaric acid, oxaloacetic acid, dioxosuccinic acid, valeric acid, isovaleric acid, 2-methylbutyric acid, pivalic acid, 3-hydroxyvaleric acid, 4-hydroxypentanoic acid, 3-hydroxyisovaleric acid, glutaric acid, 2-oxoglutaric acid, 3-oxoglutaric acid, 2-furoic acid, tetrahydrofuroic acid, hexanoic acid,

hexanedioic acid, citric acid, aconitic acid, isocitric acid, sorbic acid, pimelic acid, benzoic acid, salicylic acid, 4-carboxybenzoic acid, trimesic acid, mellitic acid, malic acid and combinations thereof; and wherein the aqueous solvent is water or a solution containing water as the major component and a minor component.

16. The method of claim 15, wherein the proportion of water in the aqueous solvent is from about 51% to about 100% by weight; and wherein the minor component is selected from the group consisting of methanol, ethanol, isopropanol, n-propanol, tert-butanol, n-butanol, acetone, dimethyl ketone, methyl ethyl ketone, ethyl acetate, isopropyl acetate, propyl acetate, butyl acetate and combinations thereof.

17. The method of claim 1, wherein the weight ratio of the composite to the delamination solution is from about 0.01% to about 5%.

18. The method of claim 14, wherein the concentration of the delamination agent in the delamination solution is from about 0.01% to about 1% by weight, based on the total weight of the delamination solution.

19. The method of claim 1, wherein the composite is immersed into the delamination solution for a time period of from about 15 minutes to about 120 minutes; and wherein the composite is immersed into the delamination solution at a temperature of from about 25 °C to about 95 °C.

20. The method of claim 1, wherein the composite-delamination solution mixture is stirred at a speed of from about 10 rpm to about 3000 rpm; and wherein the composite-delamination solution mixture is stirred for a time period of from about 1 minute to about 120 minutes.