

We claim:

1. A solid powder mixture comprising a quantity of nanocrystalline metal oxide and/or metal hydroxide particles and one or more surfactants selected from the group consisting of ethylene oxide and propylene oxide block copolymers, polysorbates,
5 sodium methacrylates, polyamide-based resin dispersants, sulfosuccinates, and octylphenol ethoxylates.
2. The mixture of claim 1, wherein said nanocrystalline particles are selected from the group consisting of MgO, CeO₂, CaO, TiO₂, ZrO₂, FeO, V₂O₃, V₂O₅,
10 Mn₂O₃, Fe₂O₃, NiO, CuO, Al₂O₃, ZnO, SiO₂, Ag₂O, SrO, BaO, Mg(OH)₂, Ca(OH)₂, Al(OH)₃, Sr(OH)₂, Ba(OH)₂, Fe(OH)₃, Cu(OH)₂, Ni(OH)₂, Co(OH)₂, Zn(OH)₂, AgOH, coated metal oxides and hydroxides, doped metal oxides and hydroxides, biocidal metal oxides and hydroxides, and mixtures thereof.
- 15 3. The mixture of claim 1, wherein said nanocrystalline particles are present in said mixture at a level of from about 70% to about 99% by weight.
4. The mixture of claim 1, wherein said one or more surfactants are present in said mixture at a level of from about 1% to about 30% by weight.
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5. The mixture of claim 1, wherein said one or more surfactants comprises a tri-block copolymer having a central hydrophobic chain of polyoxypropylene flanked by two hydrophilic chains of polyoxyethylene.
- 25 6. The mixture of claim 1, wherein the weight ratio of said nanocrystalline particles to said one or more surfactants is about 50:1 to about 2:1.
7. The mixture of claim 1, further comprising one or more additives selected from the group consisting of pH adjusters, chelating agents, thickeners, friction-
30 reducing agents, enzymes, antideposition agents, bleaching agents, optical brighteners, fabric softeners, hydrotropes, preservatives, and fragrances.

8. The mixture of claim 1, wherein said nanocrystalline particles have a crystallite size of less than about 25 nm.

5 9. The mixture of claim 1, wherein said nanocrystalline particles exhibit a Brunauer-Emmett-Teller (BET) multipoint surface area of at least about 15 m²/g.

10 10. The mixture of claim 1, wherein said mixture, when contacted with a surface contaminated with diethylamine, is capable of adsorbing at least 75% of the diethylamine on said surface.

11. A method of removing a target substance from an article comprising contacting the mixture of claim 1 with said article and causing at least a portion of said target substance to become adsorbed by said nanocrystalline particles.

15 12. The method of claim 11, wherein said target substance is a malodorous target substance selected from the group consisting of animal odors, animal waste odors, asphalt fumes, charred materials, cleaning chemicals, odors caused by decaying bodies or decaying vegetation, detergents, diaper odors, exhaust gases, fuels, volatile organic compound fumes, organic solvents, odors caused by moisture or flooding, human body odors, human waste odors, hunting odors, pesticides, kitchen odors, medicinal odors, sewer gases, smoke, garbage, other odors caused by bacteria, mildew, and fungi, and combinations thereof, and wherein said contacting step results in at least a 75% reduction in the concentration of said target substance on said article.

25 13. A liquid suspension comprising about 1 part by weight of the solid powder mixture of claim 1 per about 1 part to about 1,000 parts by weight of a liquid carrier.

30 14. The liquid suspension of claim 13, wherein said liquid carrier is selected from the group consisting of water, oils, glycerin, organic solvents, halogenated solvents, thickening agents, and mixtures thereof.

15. The liquid suspension of claim 13, wherein said liquid carrier is water.

5 16. The liquid suspension of claim 13, wherein said nanocrystalline particles are present in said suspension at a level of about 0.1% to about 50% by weight, based upon the total weight of the suspension.

10 17. The liquid suspension of claim 13, wherein said one or more surfactants are present in said suspension at a level of about 0.01% to about 10% by weight, based upon the total weight of the suspension.

15 18. The liquid suspension of claim 13, further comprising one or more additives selected from the group consisting of pH adjusters, chelating agents, thickeners, friction-reducing agents, enzymes, antideposition agents, bleaching agents, optical brighteners, fabric softeners, hydrotropes, preservatives, and fragrances.

20 19. The liquid suspension of claim 13, wherein said suspension is substantially free of oil.

20 20. The liquid suspension of claim 19, wherein said one or more surfactants comprise sulfosuccinates and/or octylphenol ethoxylates.

25 21. The liquid suspension of claim 13, wherein said suspension comprises one gram of said nanocrystalline particles dispersed within 10 mL of water, and wherein said suspension demonstrates less than 50% particulate settling for at least 3 minutes after agitation.

30 22. The liquid suspension of claim 13, wherein said suspension remains physically stable for at least about 4 days under quiescent storage conditions at 25°C.

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23. A method of treating a surface comprising applying the liquid suspension of claim 13 to the surface.

24. The method of claim 23, wherein the liquid suspension is applied by spraying the liquid suspension onto the surface.

25. The method of claim 23, wherein said method further comprises drying said aqueous suspension after application to said surface to leave a residue on the surface comprising said nanocrystalline particles.

26. The method of claim 23, said method further comprising rinsing said aqueous suspension from said surface with water after said application.

27. The method of claim 23, wherein said surface is a woven or non-woven textile surface selected from the group consisting of carpets, upholstery, fabrics, paper products, leather, and combinations thereof.

28. The method of claim 23, wherein said surface is a non-textile material selected from the group consisting of plastic, metal, wood, drywall paint, foam, and combinations thereof.

29. The method of claim 23, wherein said nanocrystalline particles are bonded to said surface upon said application of said liquid suspension, without the use of adhesives, electrostatic attachment, or physical entrapment.

30. The method of claim 23, wherein the surface is contaminated with a target substance, and wherein application of the liquid suspension to the surface causes at least a portion of the target substance to become adsorbed by said nanocrystalline particles.

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31. A liquid composition comprising a mixture of nanocrystalline particles, linseed oil, and a solvent, wherein said nanocrystalline particles comprise metal oxides and/or metal hydroxides.

5 32. The liquid composition of claim 31, wherein said nanocrystalline particles are selected from the group consisting of MgO, CeO₂, CaO, TiO₂, ZrO₂, FeO, V₂O₃, V₂O₅, Mn₂O₃, Fe₂O₃, NiO, CuO, Al₂O₃, ZnO, SiO₂, Ag₂O, SrO, BaO, Mg(OH)₂, Ca(OH)₂, Al(OH)₃, Sr(OH)₂, Ba(OH)₂, Fe(OH)₃, Cu(OH)₂, Ni(OH)₂, Co(OH)₂, Zn(OH)₂, AgOH, coated metal oxides and hydroxides, doped metal oxides and hydroxides, biocidal
10 metal oxides and hydroxides, and mixtures thereof.

 33. The liquid composition of claim 31, wherein said nanocrystalline particles are present in said composition at a level of from about 30% to about 60% by weight, based upon the total weight of the composition.

15 34. The liquid composition of claim 31, wherein said linseed oil is present in said composition at a level of from about 5% to about 30% by weight, based upon the total weight of the composition.

20 35. The liquid composition of claim 31, wherein said solvent is present in said composition at a level of from about 20% to about 50% by weight, based upon the total weight of the composition.

 36. A method of sorbing a target substance comprising contacting the
25 liquid composition of claim 31 with said target substance.

 37. A method of protecting a surface comprising:
applying the liquid composition of claim 31 to said surface; and
drying said liquid composition, thereby forming a dry coating comprising said
30 nanocrystalline particles on said surface.

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38. A liquid composition comprising a mixture of nanocrystalline particles, glycerin, water, and a surfactant, wherein said nanocrystalline particles comprise metal oxides and/or metal hydroxides.

5 39. The liquid composition of claim 38, wherein said nanocrystalline particles are selected from the group consisting of MgO, CeO₂, CaO, TiO₂, ZrO₂, FeO, V₂O₃, V₂O₅, Mn₂O₃, Fe₂O₃, NiO, CuO, Al₂O₃, ZnO, SiO₂, Ag₂O, SrO, BaO, Mg(OH)₂, Ca(OH)₂, Al(OH)₃, Sr(OH)₂, Ba(OH)₂, Fe(OH)₃, Cu(OH)₂, Ni(OH)₂, Co(OH)₂, Zn(OH)₂, AgOH, coated metal oxides and hydroxides, doped metal oxides and hydroxides, biocidal
10 metal oxides and hydroxides, and mixtures thereof.

 40. The liquid composition of claim 38, wherein said nanocrystalline particles are present in said composition at a level of from about 1% to about 10% by weight, based upon the total weight of the composition.

15 41. The liquid composition of claim 38, wherein said glycerin is present in said composition at a level of from about 1% to about 30% by weight, based upon the total weight of the composition.

20 42. The liquid composition of claim 38, wherein said water is present in said composition at a level of from about 1% to about 30% by weight, based upon the total weight of the composition.

 43. The liquid composition of claim 38, wherein said surfactant is
25 present in said composition at a level of from about 50% to about 90% by weight, based upon the total weight of the composition.

 44. The liquid composition of claim 38, wherein said surfactant is soap.

30 45. The liquid composition of claim 38, further comprising one or more additives selected from the group consisting of pH adjusters, chelating agents, thickeners,

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friction-reducing agents, enzymes, antideposition agents, bleaching agents, optical brighteners, fabric softeners, hydrotropes, preservatives, and fragrances.

5 46. A method of sorbing a target substance comprising contacting the liquid composition of claim 38 with said target substance.

10 47. A method of cleaning a surface comprising:
 applying the liquid composition of claim 38 to said surface; and
 rinsing said liquid composition from said surface.

 48. The method of claim 47, wherein said surface is skin.

15 49. The method of claim 47, wherein said surface is the surface of an inanimate object.