

CLAIMS

1. An anti-pathogen solid composition comprising an active component, wherein the active component comprises particles of at least one activated metal.
2. The anti-pathogen solid composition of claim 1, wherein the at least one activated metal is a transition metal or a transition metal oxide.
3. The anti-pathogen solid composition of claims 1 or 2, wherein the at least one activated metal is selected from Mo, Zn, Cu, Au, Ag, or an oxide thereof.
4. The anti-pathogen solid composition of claim 3, wherein the at least one activated metal is Mo, Mo(IV), Mo(V) or Mo(VI), or an oxide thereof.
5. The anti-pathogen solid composition of claim 3, wherein the at least one activated metal is selected from Mo, MoO₂, MoO₃, MoO₅, Mo₂O₆, H₂MoO₅, Zn, ZnO, Cu, Cu₂O, CuO, Au, AuO, Au₂O₃, Ag, and Ag₂O.
6. The anti-pathogen solid composition claim 5, wherein the at least one activated metal is Mo, MoO₂, MoO₃, H₂MoO₅, or Mo₂O₆.
7. The anti-pathogen solid composition of any one of claims 1-3, wherein the at least one activated metal is Mo, or an oxide thereof, having a cubic, spherical, monoclinic, hexagonal, orthorhombic, tetragonal, triclinic, or rhombohedral crystal structure.
8. The anti-pathogen solid composition of any one of claims 1-7, wherein the anti-pathogen solid composition comprises about 0.1% to about 99% by weight of the active component.
9. The anti-pathogen solid composition of any one of claim 1-8, wherein the anti-pathogen solid composition comprises about 0.1% to about 50% by weight of the active component.

10. The anti-pathogen solid composition of any one of claim 1-9, wherein the anti-pathogen solid composition comprises about 0.1% to about 15% by weight of the active component.
11. The anti-pathogen solid composition of any one of claims 1-10, wherein the anti-pathogen solid composition comprises about 0.1% to about 5% by weight of the active component.
12. The anti-pathogen solid composition of any one of claims 1-11, wherein the anti-pathogen solid composition comprises about 0.1% to about 3% by weight of the active component.
13. The anti-pathogen solid composition of any one of claims 1-12, wherein the anti-pathogen solid composition comprises about 0.1% to about 2% by weight of the active component.
14. The anti-pathogen solid composition of any one of claims 1-13, wherein the anti-pathogen solid composition comprises about 0.1% to about 1% by weight of the active component.
15. The anti-pathogen solid composition of any one of claims 1-14, wherein the particles of the at least one active metal have a size of about 1 μm to about 1000 μm .
16. The anti-pathogen solid composition of any one of claims 1-15, wherein the particles of the at least one active metal have a size of about 10 μm to about 85 μm .
17. The anti-pathogen solid composition of any one of claims 1-16, wherein the particles of the at least one active metal have a size of about 10 μm to about 50 μm .
18. The anti-pathogen solid composition of any one of claims 1-17, wherein the particles of the at least one active metal have a size of about 20 μm to about 50 μm .

19. The anti-pathogen solid composition of any one of claims 1-18, wherein the particles of the at least one active metal have a size of about 30 μm to about 50 μm .
20. The anti-pathogen solid composition of any one of claims 1-19, wherein the particles of the at least one active metal have a size of about 40 μm to about 50 μm .
21. The anti-pathogen solid composition of any one of claims 1-20, wherein the particles of the at least one active metal have a size of about 40 μm to about 45 μm .
22. The anti-pathogen solid composition of any one of claims 1-21, further comprising a second metal or metal oxide.
23. The anti-pathogen solid composition of claim 22, wherein the second metal is selected from Ni, Zn, Mn, Au, Ag, Cu, and Pd, or oxides thereof.
24. The anti-pathogen solid composition of claims 22 or 23, wherein the second metal is selected from Zn or ZnO.
25. The anti-pathogen solid composition of any one of claims 22-24, wherein the anti-pathogen solid composition comprises about 0.1% to about 99% by weight of the second metal.
26. The anti-pathogen solid composition of any one of claims 22-25, wherein the anti-pathogen solid composition comprises about 0.1% to about 75% by weight of the second metal.
27. The anti-pathogen solid composition of any one of claims 22-26, wherein the anti-pathogen solid composition comprises about 0.1% to about 50% by weight of the second metal.
28. The anti-pathogen solid composition of any one of claims 22-27, wherein the anti-pathogen solid composition comprises about 0.1% to about 15% by weight of the second metal.

29. The anti-pathogen solid composition of any one of claims 22-28, wherein the anti-pathogen solid composition comprises about 0.1% to about 5% by weight of the second metal.
30. The anti-pathogen solid composition of any one of claims 22-29, wherein the anti-pathogen solid composition comprises about 0.1% to about 3% by weight of the second metal.
31. The anti-pathogen solid composition of any one of claims 22-30, wherein the anti-pathogen solid composition comprises about 0.1% to about 1% by weight of the second metal.
32. The anti-pathogen solid composition of any one of claims 1-31, further comprising an antioxidant.
33. The anti-pathogen solid composition of claim 32, wherein the antioxidant is pentaerythritol tetrakis[3-[3,5-di-tert-butyl-4-hydroxyphenyl]propionate (Irganox® 1010) and tris(2,4-di-tert.-butylphenyl)phosphite (Irgafos® 168).
34. The anti-pathogen solid composition of any one of claims 1-33, wherein the anti-pathogen solid composition is or comprises a material selected from polymers, biopolymers, plastics, ceramics, rubbers, paints, ointments, glasses, silicones, papers, fabric, metals, and combinations thereof.
35. The anti-pathogen solid composition of claim 34, wherein the anti-pathogen solid composition is or comprises a polymer.
36. The anti-pathogen solid composition of claim 35, wherein the polymer is selected from polypropylenes, polystyrenes, polyethylenes, polyesters, polycarbonates, polyurethanes, polyvinylchlorides, and combinations thereof.
37. The anti-pathogen solid composition of claims 35 or 36, wherein the polymer is a polypropylene.

38. The anti-pathogen solid composition of any one of claims 1-37, wherein the anti-pathogen solid composition is flexibly formed to cover a surface.
39. The anti-pathogen solid composition of claim 34, wherein the material is a metal (e.g., a stainless steel).
40. The anti-pathogen solid composition of claim 39, wherein the metal is or comprises a stainless steel.
41. An anti-pathogen composition comprising:
about 0.01% to about 5% by weight of an active component, wherein the active component comprises particles of an activated transition metal or transition metal oxide; and
about 1% to about 99.99% by weight of a polymer.
42. An anti-pathogen composition comprising:
about 0.01% to about 5% by weight of an active component, wherein the active component comprises particles of an activated transition metal or transition metal oxide; and
about 1% to about 99.99% by weight of a stainless steel.
43. An anti-pathogen suspension comprising particles of an active component and a water or saline solution, wherein the active component comprises particles of at least one activated metal.
44. The anti-pathogen suspension of claim 43, wherein the pH of the suspension is about 5.5 or less.
45. The anti-pathogen suspension of claim 44, wherein the pH of the suspension is about 4.0 or less.
46. The anti-pathogen suspension of claim 45, wherein the pH of the suspension is about 2.0 or less.

47. The anti-pathogen suspension of claim 46, wherein the pH of the suspension is about 1.5 or less.
48. The anti-pathogen suspension of any one of claims 43-47, wherein the weight ratio of the activated metal to the saline solution is from about 1:100 to about 1:1.
49. The anti-pathogen suspension of claim 48, wherein the weight ratio of the activated metal to the saline solution is from about 1:100 to about 1:25.
50. The anti-pathogen suspension of claim 49, wherein the weight ratio of the activated metal to the saline solution is from about 1:100 to about 1:50.
51. The anti-pathogen suspension of claim 50, wherein the weight ratio of the activated metal to the saline solution is from about 1:100 to about 1:75.
52. The anti-pathogen suspension of claim 51, wherein the weight ratio of the activated metal to the saline solution is about 1:100.
53. The anti-pathogen suspension of any one of claims 43-52, wherein the suspension is a lotion, ointment, gel, paste, or a cream.
54. A method for neutralizing pathogens on a surface, the method comprising a step of contacting the surface with the anti-pathogen suspension of any one of claims 43-53.
55. The method of claim 54, wherein the surface is human skin.
56. The method of claims 54 or 55, wherein the pathogens are selected from Gram positive bacteria, Gram negative bacteria, fungi, viruses, and algae.
57. The method of any one of claims 54-56, wherein the pathogens are selected from micrococcus, staphylococcus, bacillus, pseudomonas, legionella, salmonella, listeria, clostridium

perfringens, *Acinetobacter baumannii*, *Escherichia coli*, coronaviruses, rhinoviruses, influenza, norovirus, adenovirus, parainfluenza, respiratory syncytial virus, and enterovirus.

58. A water-permeable pouch comprising an active component, wherein the active component is or comprises particles of an activated metal.

59. The water-permeable pouch of claim 58, further comprising a pH indicator.

60. A method for neutralizing pathogens in a water sample, the method comprising a step of contacting the water sample with the water-permeable pouch of claims 58 or 59 for a period of time sufficient to neutralize the pathogens in the water sample.

61. The method of claim 60, wherein the method further comprises contacted the water sample with ZnO to neutralize the pH.

62. An anti-pathogen liquid composition comprising particles of an active component and a water or saline solution, wherein the active component comprises at least one activated metal.

63. The anti-pathogen liquid composition of claim 62, wherein the pH of the liquid composition is about 5.5 or less.

64. The anti-pathogen liquid composition of claim 63, wherein the pH of the liquid composition is about 4.0 or less.

65. The anti-pathogen liquid composition of claim 64, wherein the pH of the liquid composition is about 2.0 or less.

66. The anti-pathogen liquid composition of claim 65, wherein the pH of the liquid composition is about 1.5 or less.

67. The anti-pathogen liquid composition of any one of claims 62-66, wherein the weight ratio of the activated metal to the water or saline solution is from about 1:100 to about 1:1.

68. The anti-pathogen liquid composition of claim 67, wherein the weight ratio of the activated metal to the water or saline solution is from about 1:100 to about 1:25.

69. The anti-pathogen liquid composition of claim 68, wherein the weight ratio of the activated metal to the water or saline solution is from about 1:100 to about 1:50.

70. The anti-pathogen liquid composition of claim 69, wherein the weight ratio of the activated metal to the water or saline solution is from about 1:100 to about 1:75.

71. The anti-pathogen liquid composition of claim 70, wherein the weight ratio of the activated metal to the water or saline solution is about 1:100.

72. A fabric treated with the anti-pathogen liquid composition of any one of claims 62-70.