CLAIMS

1. An air-permeable substrate structure for use in a non-hydrated purified hydrogen peroxide gas (PHPG)-generating device comprising
    a. an air permeable a mesh having a percentage of open area between 20% and 60% after coating; and
    b. a photocatalyst disposed on its surface, wherein said photocatalyst on said air-permeable substrate structure is between 5 nm and 750 nm thick.

2. The structure of claim 1, wherein said mesh has a percentage of open area between 36% and 38%.

3. The structure of claim 1, wherein said mesh has a percentage of open area of 37%.

4. The structure of claim 1, wherein said mesh has a percentage of open area between 30 and 60%.

5. The structure of claim 1, wherein said air-permeable substrate structure has a pH of greater than 7.0 on said photocatalyst surface.

6. The structure of claim 1, wherein said air-permeable substrate structure has a pH of between 7.0 and 9.0 on said photocatalyst surface.

7. The structure of claim 1, wherein said photocatalyst is a metal, a metal oxide, or mixtures thereof.

8. The structure of claim 7, wherein said metal or metal oxide photocatalyst is selected from the group consisting of titanium dioxide, copper, copper oxide, zinc, zinc oxide, iron, iron oxide, tungsten, tungsten trioxide, and mixtures thereof.

9. The structure of claim 7, wherein said metal or metal oxide photocatalyst further comprises a co-catalyst selected from platinum, silver, gold, nickel, palladium, cesium, copper, rhodium, ruthenium, osmium, iridium, zirconium dioxide, titanium dioxide ceramic, or extruded ceramic.

10. The structure of claim 1, wherein said photocatalyst comprises one or more additives.

11. The structure of claim 10, wherein said one or more additives is a hygroscopic additive.

12. The structure of claim 11, wherein said hygroscope additive is selected from the group consisting of: sodium bicarbonate, potassium bicarbonate, sodium carbonate, potassium carbonate, magnesium carbonate, magnesium bicarbonate, sodium hydroxide, potassium hydroxide, magnesium hydroxide, zinc chloride, calcium chloride, magnesium chloride, sodium phosphate, potassium phosphate, magnesium phosphate, carnallite, ferric ammonium citrate, nylon, acrylonitrile butadiene styrene (ABS), polycarbonate, cellulose, poly(methyl methacrylate), and combinations thereof.

13. The structure of claim 9, wherein said co-catalyst comprises up to 5% of the total mass of the photocatalyst.

14. The structure of claim 9, wherein said co-catalyst comprises less than 0.05% of the total mass of the photocatalyst.

15. The structure of claim 1, wherein said air-permeable substrate structure comprises a plastic woven mesh having a thread thickness of between 48 x 10^{-6} meters (microns) and 175 microns.

16. The structure of claim 1, wherein said air-permeable substrate structure comprises a plastic woven mesh having a hole size of between 25 x 10^{-6} (microns) and 220 microns.

17. The structure of claim 1, wherein said catalyst on a surface of said substrate structure is between 20 x 10^{-9} meters (nm) and 40 nm thick.

18. The structure of claim 1, wherein said catalyst on a surface of said substrate structure is between 100 x 10^{-9} meters (nm) and 200 nm thick.

19. The structure of claim 1, wherein said catalyst on a surface of said substrate structure is selected from the group consisting of between 250 x 10^{-9} meters (nm) to 500 nm and between 500 nm to 750 nm thick.

20. The structure of claim 9, wherein mixtures of said co-catalysts have a combined amount of up to 10% of the total mass of the photocatalyst.

21. An air-permeable substrate structure for use in a non-hydrated purified hydrogen peroxide gas (PHPG)-generating device comprising

a. a woven mesh having a photocatalyst disposed on its surface;

b. wherein said mesh has a hole size of between 25 x10^{-6} meters (μm) and 220 μm;

c. wherein said mesh has a thread thickness of between 48 μm and 175 μm; and

d. wherein said mesh has a percentage of open area between 30% and 50% after coating.

22. An air-permeable substrate structure for use in a non-hydrated purified hydrogen peroxide gas (PHPG)-generating device comprising

a. a woven mesh having a photocatalyst disposed on its surface;

b. wherein said photocatalyst is between 5 x10^{-9} meters (nm) and 750 nm thick;

c. and wherein said photocatalyst comprises titanium dioxide , wherein said mesh has a percentage of open area between 30% and 50% after coating.

23. The air-permeable substrate structure of claim 21, wherein said photocatalyst is a metal, a metal oxide, or mixture thereof.

24. The air-permeable substrate structure of claim 21, wherein said photocatalyst further comprises a co-catalyst, and wherein said co-catalyst comprises 5% or less of the total mass of the photocatalyst.

25. The air-permeable substrate structure of claim 22, wherein said mesh has a hole size of between 25 x10^{-6} meters (μm) and 220 μm, and a thread thickness of between 48 μm and 175 μm.

26. The air-permeable substrate structure of claim 22, wherein said mesh has a percentage of open area between 30% and 40% after coating.

27. The air-permeable substrate structure of claim 22, wherein said photocatalyst is a metal, a metal oxide, or mixture thereof.

28. The air-permeable substrate structure of claim 22, wherein said photocatalyst further comprises a co-catalyst, and wherein said co-catalyst comprises up to 10% of the total mass of the photocatalyst.

29. The air-permeable substrate structure of claim 1, wherein said mesh has a hole size of between 25 $x10^{-6}$ meters (μm) and 220 μm, and a thread thickness of between 48 μm and 175 μm.

30. The air-permeable substrate structure of any one of claims 1 to 21, wherein said photocatalyst comprises crystalline titanium dioxide.

31. The air-permeable substrate structure of any one of claims 1 to 21, wherein said photocatalyst comprises a blend of tungsten trioxide (WO_3) and titanium dioxide (TiO_2).

32. The air-permeable substrate structure of claim 30, wherein said crystalline titanium dioxide is sintered.

33. The air-permeable substrate structure of claim 1, wherein said mesh is a plastic mesh.

34. The air-permeable substrate structure of claim 32, wherein said plastic is selected from the group consisting of nylon, polybutylene terephthalate (PBT), polyester, polyethylene, polypropylene, polytetrafluoroethylene (PTFE), and polypropylene/polyethylene (PP/PE) blends.