CLAIMS

1. An air-permeable substrate structure comprising
    a. a mesh having a percentage of open area between 10 and 60%; and
    b. a catalyst disposed on its surface;

wherein said air-permeable substrate structure is between 5 nm and about 750 nm thick.

2. The structure of claim 1, wherein said percentage of open area is between 20 and 60%.

3. The structure of claim 1, wherein said percentage of open area is between 36 and 38%.

4. The structure of claim 1, wherein said percentage of open area is about 37%.

5. The structure of claim 1, wherein said mesh has a percentage of open area selected from the group consisting of 37%, between 20 and 60%, between 36 and 38%, between 10% to 20%, between 20% to 30%, between 30% to 40%, between 40% to 50%, and between 50% to 60%.

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

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

8. The structure of claim 1, wherein the thickness of said mesh is between 20 nm and 40 nm.

9. The structure of claim 1, wherein the thickness of said mesh is between 100nm and 200nm.

10. The structure of claim 1, wherein the thickness of said mesh is selected from the group consisting of 5 nm to 15 nm, 15 nm to 30 nm, 30 nm to 50 nm, 50 nm to 75 nm, 75 nm to 100 nm, 100 nm to 250 nm, 250 nm to 500 nm, and 500 nm to 750 nm.

11. The structure of claim 1, wherein said catalyst is a metal or metal oxide catalyst.

12. The structure of claim 1, wherein said metal or metal oxide catalyst is selected from the group consisting of titanium dioxide, copper, copper oxide, zinc, zinc oxide, iron, iron oxide, tungsten, tungsten trioxide, and mixtures thereof.

13. The structure of claim 1, wherein said metal or metal oxide catalyst further comprises a co-catalyst selected from platinum, silver, gold, nickel, palladium, titanium dioxide ceramic, or extruded ceramic.

14. The structure of claim 1, wherein said catalyst comprises one or more additives.

15. The structure of claim 14, wherein said one or more additives is a hygroscopic additive.

16. The structure of claim 15, 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, and poly(methyl methacrylate).

17. The structure of claim 13, wherein said co-catalyst is at levels up to about 0.05%, about 5%, about 10%, or about 1% of the total mass of the catalyst.

18. The structure of claim 13, wherein said co-catalyst is at levels of 5% or less or less than 0.05% of the total mass of the catalyst.

19. The structure of claim 13, wherein said co-catalyst is between 0.005 and 0.05%, between 0.01 and 0.05%, or between 0.01 and 0.02% of the total mass of the catalyst.

20. The structure of claim 1, wherein said air-permeable substrate structure comprises an incident angle of 90°, at least 14°, or between 68° and 90°, relative to an airflow.