contaminants in the air by fractioning large organic molecules into multiple small organic molecules such as formaldehyde.

[0020] Methods of vaporizing aqueous hydrogen peroxide solutions produce, at best, hydrated forms of hydrogen peroxide. Also, though photocatalytic systems are capable of producing hydrogen peroxide, they have multiple limitations that severely inhibit PHPG production for release into the environment. We have previously disclosed methods and devices for producing PHPG in U.S. Application No. 12/187,755, published May 1, 2012, as U.S. Patent Publication No. 2009/0041617, and hereby incorporated by reference in its entirety.

FIELD OF THE DISCLOSURE

[0021] The present application provides for and includes improved devices and methods for generating Purified Hydrogen Peroxide Gas (PHPG).

SUMMARY

[0022] The present disclosure provides for, and includes, improved devices for producing non-hydrated purified hydrogen peroxide gas (PHPG) comprising an enclosure, an air distribution mechanism providing an airflow, an air-permeable substrate structure having a catalyst on its surface, a source of light, wherein the airflow is through said air-permeable substrate structure and the device produces PHPG and directs it out of said enclosure when in operation.

[0023] The present disclosure provides for, and includes, a device for producing non-hydrated purified hydrogen peroxide gas (PHPG) when installed into a heating, ventilating, and air conditioning (HVAC) system comprising an air-permeable substrate structure having a catalyst on its surface and a source of light wherein air flows from the HVAC system through the air-permeable substrate structure and the device produces PHPG and directs it away from the air-permeable substrate structure when in operation and into a heated, ventilated and air conditioned space.

[0023a] In one aspect, the present disclosure relates to a device for producing non-hydrated purified hydrogen peroxide gas (PHPG) comprising:

a. an enclosure;

b. an air distribution mechanism providing an airflow;

c. an air-permeable substrate structure between 5 and 750 nm thick having a catalyst on its surface;

d. a source of ultraviolet (UV) light; and

wherein

said airflow is through said air-permeable substrate structure; and

said device produces PHPG and directs it out of said enclosure when in operation.

[0023b] In another aspect, the present disclosure relates to a device for producing non-hydrated purified hydrogen peroxide gas (PHPG) when installed into a heating, ventilating, and air conditioning (HVAC) system comprising:

a. an air-permeable substrate structure less than 750 nm thick having a catalyst on its surface and is a mesh having an open area of between 20% and 60%; and

b. a source of ultraviolet (UV) light;

wherein air flows from the HVAC system through said air-permeable substrate structure and said device produces PHPG and directs it away from said air-permeable substrate structure having a catalyst on its surface when in operation and into a heated, ventilated and air conditioned space.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] Figures 1A to 1C are illustrations of an embodiment of the present disclosure designed to be installed as part of an HVAC system. Notably, the enclosure and air distribution

CLAIMS

1. A device for producing non-hydrated purified hydrogen peroxide gas (PHPG) comprising:
    a. an enclosure;
    b. an air distribution mechanism providing an airflow;
    c. an air-permeable substrate structure between 5 and 750 nm thick having a catalyst on its surface;
    d. a source of ultraviolet (UV) light; and

    wherein

    said airflow is through said air-permeable substrate structure; and

    said device produces PHPG and directs it out of said enclosure when in operation.

2. The device of claim 1, wherein said airflow comprises an angle of incidence to said substrate structure that is greater than 14°.

3. The device of claim 1, wherein said airflow comprises air having a humidity of at least 5%.

4. The device of claim 1, wherein said air-permeable substrate structure is a mesh having a percentage of open area between 10% and 60%.

5. The device of claim 1, wherein said ultraviolet light illuminates said air-permeable substrate structure with light having an intensity of between 0.1 watts per square inch and 150 watts per square inch at the surface of said substrate.

6. The device of claim 5, wherein said intensity is between 2.5 and 7.4 watts per square inch.

7. The device of claim 1, wherein said ultraviolet light comprises a wavelength that is between 190 nm and 460 nm.

8. The device of claim 7, further comprising a filter that blocks ultraviolet light having a wavelength of 188 nm or less.

9. The device of claim 7, wherein said wavelength of ultraviolet light is between 340 nm and 380 nm.

10. The device of claim 9, wherein at least 90% of the power of said light is emitted between 340 nm and 380 nm.

11. The device of claim 7, wherein less than 1% of said light is ultraviolet B radiation having a wavelength of between 280 nm and 315 nm.

12. The device of claim 1, further comprising one or more filters to remove one or more contaminants from said airflow prior to flowing through said air-permeable substrate structure selected from the group consisting of nitrogen oxide (NOx), sulfur oxide (Sox), volatile organic molecules (VOM), household dust, pollen, dust-mite debris, mold spores, pet dander, smoke, smog, and bacteria.

13. The device of claim 1, wherein said airflow flows through said air-permeable substrate structure at a flow rate of 5 nanometers/second (nm/s) to 10,000 nm/s.

14. The device of claim 1, wherein said air-permeable substrate structure further comprises a hygroscopic additive.

15. The device of claim 14, wherein said hygroscopic 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).

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

17. A device for producing non-hydrated purified hydrogen peroxide gas (PHPG) when installed into a heating, ventilating, and air conditioning (HVAC) system comprising:
    a. an air-permeable substrate structure less than 750 nm thick having a catalyst on its surface and is a mesh having an open area of between 20% and 60%; and
    b. a source of ultraviolet (UV) light;
    wherein air flows from the HVAC system through said air-permeable substrate structure and said device produces PHPG and directs it away from said air-permeable substrate structure having a catalyst on its surface when in operation and into a heated, ventilated and air conditioned space.

18. The device of claim 17, wherein said airflow comprises an angle of incidence to said substrate structure that is at least 14°.

19. The device of claim 17, further comprising a filter that blocks ultraviolet light having a wavelength of 188 nm or less.

20. The device of claim 17, wherein said air has a residence time on said catalyst surface of less than a second.