

What is claimed is:

CLAIMS

1. A water treatment system comprising:
5 an actinic radiation reactor; and
at least one ultraviolet (UV) lamp disposed within a quartz tube within the actinic radiation reactor, the at least one UV lamp including:
a lamp tube including a gas that emits ultraviolet light responsive to electrical excitation;
10 a first pinch extending from a first end of the lamp tube and a second pinch extending from a second end of the lamp tube; and
a first end cap coupled to the first pinch and a second end cap coupled to the second pinch, the first end cap and second end cap dimensioned to center the lamp tube coaxially within the quartz tube.
15
2. The system of claim 1, wherein the UV lamp further includes thermally conductive biasing elements disposed about respective peripheries of each of the first end cap and second end cap.
- 20 3. The system of claim 2, wherein the thermally conductive biasing elements comprise metallic springs.
4. The system of any one of claims 2-3, wherein the thermally conductive biasing elements are disposed within grooves defined within and circumscribing
25 outer peripheral surfaces of the first end cap and the second end cap.
5. The system of claim 4, wherein portions of the outer peripheral surfaces of the first end cap and second end cap are contoured to conform to an inner surface of the quartz tube.
30
6. The system of claim 4, wherein the first and second end caps include slots extending inwardly from the outer peripheral surfaces.

7. The system of claim 6, wherein the slots are perpendicular to the grooves.
8. The system of claim 6, further comprising an electrical conductor configured to provide power to the lamp tube disposed within the slots.
- 5 9. The system of claim 8, wherein the metallic springs retain the conductor within the slots.
- 10 10. The system of claim 2, wherein the thermally conductive biasing elements contact an inner surface of the quartz tube, support the lamp tube within the quartz tube, and dampen vibrations passing from the quartz tube to the first and second end caps.
- 15 11. The system of claim 1, wherein, in operation, the lamp tube exhibits a symmetric temperature profile from the first pinch to the second pinch.
12. The system of claim 1, wherein the actinic radiation reactor is an ultraviolet advanced oxidation process reactor.
- 20 13. A method of treating water, the method comprising:
introducing the water into an inlet of an actinic radiation reactor including at least one ultraviolet (UV) lamp disposed within a quartz tube within the actinic radiation reactor, the at least one UV lamp including:
a lamp tube including a gas that emits ultraviolet light responsive to
25 electrical excitation;
a first pinch extending from a first end of the lamp tube and a second pinch extending from a second end of the lamp tube; and
a first end cap coupled to the first pinch and a second end cap coupled to the second pinch, the first end cap and second end cap dimensioned to center
30 the lamp tube coaxially within the quartz tube;
irradiating the water within the actinic radiation reactor with UV light from the at least one UV lamp to produce treated water; and
withdrawing the treated water from the actinic radiation reactor.

14. A ultraviolet (UV) lamp configured to be disposed within a quartz tube within an actinic radiation reactor, the UV lamp comprising:
- 5 a lamp tube including a gas that emits ultraviolet light responsive to electrical excitation;
- a first pinch extending from a first end of the lamp tube and a second pinch extending from a second end of the lamp tube;
- a first end cap coupled to the first pinch and a second end cap coupled to the second pinch, the first end cap and second end cap dimensioned to center the lamp tube coaxially within the quartz tube; and
- 10 a means for vibrationally isolating at least one of the first end cap and the second end cap from the quartz tube disposed about respective peripheries of each of the first end cap and second end cap.
- 15 15. The UV lamp of claim 14, wherein the means for vibration dampening comprises a thermally conductive element.
16. The UV lamp of claim 15, wherein the thermally conductive elements comprise metallic springs.
- 20 17. The UV lamp of claim 16, wherein the metallic springs are disposed within grooves defined within and circumscribing outer peripheral surfaces of the first end cap and the second end cap.
- 25 18. The UV lamp of claim 17, wherein portions of the outer peripheral surfaces of the first end cap and second end cap are contoured to conform to an inner surface of the quartz tube.
- 30 19. The UV lamp of claim 17, wherein the first and second end caps include slots extending inwardly from the outer peripheral surfaces.
20. The UV lamp of claim 19, wherein the slots are perpendicular to the grooves.

21. The UV lamp of claim 19, further comprising an electrical conductor configured to provide power to the lamp tube disposed within the slots.

5 22. The UV lamp of claim 21, wherein the metallic springs retain the electrical conductor within the slots.

10 23. The UV lamp of claim 15, wherein the thermally conductive elements contact an inner surface of the quartz tube, support the lamp tube within the quartz tube, and dampen vibrations passing from the quartz tube to the first and second end caps.

24. The UV lamp of claim 14, wherein, in operation, the lamp tube exhibits a symmetric temperature profile from the first pinch to the second pinch.

15 25. A method of retrofitting an actinic radiation reactor, the method comprising: replacing at least one ultraviolet (UV) lamp within the actinic radiation reactor with a replacement lamp, the replacement lamp including:
a lamp tube including a gas that emits ultraviolet light responsive to electrical excitation;
20 a first pinch extending from a first end of the lamp tube and a second pinch extending from a second end of the lamp tube; and
a first end cap coupled to the first pinch and a second end cap coupled to the second pinch, the first end cap and second end cap dimensioned to center the lamp tube coaxially within a quartz tube in the actinic radiation reactor.

25