CLAIMS

1. A water treatment system comprising:

an actinic radiation reactor;

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;

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

thermally conductive biasing elements,

wherein the thermally conductive biasing elements are disposed: (a) about respective peripheries of each of the first end cap and second end cap; and (b) within grooves defined within and circumscribing outer peripheral surfaces of the first end cap and the second end cap; and

wherein the first and second end caps include slots extending inwardly from the outer peripheral surfaces; and

an electrical conductor configured to provide power to the lamp tube disposed within the slots.

2. The system of claim 1, wherein the thermally conductive biasing elements comprise metallic springs.

3. The system of claim 1, 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.

4. The system of claim 1, wherein the slots are perpendicular to the grooves.

5. The system of claim 2, wherein the metallic springs retain the conductor within the slots.

6. The system of claim 1, 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.

7. The system of claim 1, wherein, in operation, the lamp tube is specially configured to exhibit a symmetric temperature profile from the first pinch to the second pinch.

8. The system of claim 1, wherein the actinic radiation reactor is specially configured to exhibit an ultraviolet advanced oxidation process.

9. 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 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;

thermally conductive biasing elements,

wherein the thermally conductive biasing elements are disposed: (a) about respective peripheries of each of the first end cap

and second end cap; and (b) within grooves defined within and circumscribing outer peripheral surfaces of the first end cap and the second end cap; and

wherein the first and second end caps include slots extending inwardly from the outer peripheral surfaces; and

an electrical conductor configured to provide power to the lamp tube disposed within the slots;

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.

10. An ultraviolet (UV) lamp configured to be disposed within a quartz tube within an actinic radiation reactor, the UV lamp comprising:

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;

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,

wherein the means for vibration dampening comprises a thermally conductive element;

wherein the thermally conductive elements comprise metallic springs disposed within grooves defined within and circumscribing outer peripheral surfaces of the first end cap and the second end cap; and

wherein the first and second end caps include slots extending inwardly from the outer peripheral surfaces; and

an electrical conductor configured to provide power to the lamp tube disposed within the slots.

11. The UV lamp of claim 10, 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.

12. The UV lamp of claim 10, wherein the slots are perpendicular to the grooves.

13. The UV lamp of claim 10, wherein the metallic springs retain the electrical conductor within the slots.

14. The UV lamp of claim 10, 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.

15. The UV lamp of claim 10, wherein, in operation, the lamp tube is specially configured to exhibit a symmetric temperature profile from the first pinch to the second pinch.

16. 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;

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 a quartz tube in the actinic radiation reactor;

thermally conductive biasing elements,

wherein the thermally conductive biasing elements are disposed: (a) about respective peripheries of each of the first end cap and second end cap; and (b) within grooves defined within and circumscribing outer peripheral surfaces of the first end cap and the second end cap; and

wherein the first and second end caps include slots extending inwardly from the outer peripheral surfaces; and

an electrical conductor configured to provide power to the lamp tube disposed within the slots.