What is claimed is:

1. An advanced oxidation ultrapure water treatment system configured to provide treated ultrapure water to a semiconductor manufacturing unit comprising:

a source of ultrapure water having a total organic carbon (TOC) concentration;

an actinic radiation reactor comprising:

a vessel having an inlet fluidly connected to the source of ultrapure water, and an outlet fluidly connected to the semiconductor manufacturing unit; and

a first array of ultraviolet lamps enclosed in tubes positioned within the vessel and secured at each end of each of the tubes to a wall of the vessel, the first array comprising a first set of parallel tubes and a second set of parallel tubes, each tube of the second set of parallel tubes having a respective longitudinal axis that is orthogonal to a respective longitudinal axis of each tube of the first set of parallel tubes, the first set of parallel tubes and the second set of parallel tubes positioned orthogonal to each other on a horizontal axis, and the first set of parallel tubes and the second set of parallel tubes at approximately the same elevation in the vessel;

a source of a free radical precursor compound fluidly connected to the actinic radiation reactor; and

a water distribution system fluidly connected to the outlet of the actinic radiation reactor to provide treated ultrapure water having a TOC concentration of less than 1 ppb to an inlet of the semiconductor manufacturing unit.

2. The system of claim 1, further comprising a second array of ultraviolet lamps enclosed in tubes comprising a third set of parallel tubes and a fourth set of parallel tubes, each tube of the fourth set of parallel tubes having a respective longitudinal axis that is orthogonal to a respective longitudinal axis of the third set of parallel tubes.

3. The system of claim 2, wherein each tube of the fourth set of parallel tubes has a longitudinal axis that is orthogonal to the respective longitudinal axis of one of the second set of parallel tubes and the first set of parallel tubes.

4. The system of claim 2, wherein the second array is positioned a predetermined distance from the first array.

5. The system of claim 2, wherein each end of each tube is secured to a wall of the vessel.

6. The system of claim 2, wherein the tubes of at least one of the first array and the second array extend across an inner volume of the vessel.

7. The system of claim 2, wherein one of the first set of parallel tubes and the second set of parallel tubes is positioned a predetermined distance from one of the third set of parallel tubes and the fourth set of parallel tubes.

8. The system of claim 1, wherein the vessel is a plug flow reactor.

9. The system of claim 8, wherein the vessel is sized to provide a residence time sufficient to allow the free radical precursor compound in the ultrapure water to convert an organic species to an inert compound.

10. The system of claim 1, further comprising a baffle positioned in the vessel to define a first chamber and a second chamber, the first chamber in fluid communication with an inlet of the reactor and the second chamber in fluid communication with an outlet of the reactor.

11. The system of claim 10, wherein the first chamber and the second chamber of the vessel each have at least one ultraviolet lamp disposed to irradiate the ultrapure water with light ranging from about 185 nm to about 254 nm.

12. The system of claim 11, wherein the at least one ultraviolet lamp can be adjusted to provide illumination at various intensities.

13. The system of claim 1, wherein the ultraviolet lamps are disposed to provide a uniform level of intensity in the reactor.

14. The system of claim 13, wherein the tubes are equispacially arranged in the vessel.

15. The system of claim 1, wherein the actinic radiation reactor can operate in a first mode indicative of a first lamp configuration and a first lamp intensity.

16. The system of claim 15, wherein the actinic radiation reactor can operate in a second mode indicative of a second lamp configuration and a second lamp intensity.

17. The system of claim 16, wherein the actinic radiation reactor can operate in a third mode indicative of a third lamp configuration and a third lamp intensity.

18. The system of claim 1, further comprising a degasifier fluidly connected downstream of the actinic radiation reactor.

19. The system of claim 18, further comprising a particulate removal system fluidly connected downstream of the degasifier.

20. The system of claim 1, further comprising a source of reducing agent fluidly connected downstream from the actinic radiation reactor.

21. The system of claim 1, wherein the free radical precursor is a persulfate precursor.