What is claimed is:

1. A serial filtration system for liquid purification, comprising:

a preliminary-stage reverse-osmosis module, comprising:

(a) a preliminary-stage chamber including a preliminary-stage inlet; a preliminary-stage retentate outlet; and a preliminary-stage permeate outlet; and

(b) at least one preliminary-stage reverse-osmosis membrane mounted in the preliminary-stage chamber and separating the preliminary-stage chamber into a retentate side, including the preliminary-stage inlet and the preliminary-stage retentate outlet, on an upstream side of the at least one preliminary-stage reverse-osmosis membrane and a permeate side, including the preliminary-stage permeate outlet, on a downstream side of the at least one preliminary-stage reverse-osmosis membrane;

a first-stage reverse-osmosis module, comprising:

(a) a first-stage chamber including a first-stage inlet; a first-stage retentate outlet; and a first-stage permeate outlet; and

(b) at least one first-stage oxidized membrane, comprising an oxidized polyamide active layer coated on a porous support, wherein the oxidized polyamide active layer has an atomic oxygen/nitrogen ratio of at least 1.5:1, and wherein the at least one first-stage oxidized membrane is mounted in the first-stage chamber and separates the first-stage chamber into a retentate side, including the first-stage inlet and the first-stage retentate outlet, on an upstream side of at least one first-stage oxidized membrane and a permeate side, including the first-stage permeate outlet, on a downstream side of the at least one first-stage oxidized membrane; and

a first-stage-inlet passage providing fluid communication between the preliminary-stage retentate outlet and the first-stage inlet and configured to

direct retentate from the retentate side of the preliminary-stage chamber through the at least one first-stage oxidized membrane in the first-stage chamber.

2. The serial filtration system of claim 1, wherein the oxidized polyamide active layer includes chlorine at a concentration of 1-10 atomic percent.

3. The serial filtration system of claim 1, wherein the oxidized polyamide active layer is formed by exposing the polyamide active layer to a sodium-hypochlorite solution at a concentration-time in a range from 5,000 to 50,000 parts per million × hours.

4. The serial filtration system of claim 1, further comprising a first-stage-permeate-outlet passage configured to provide first-stage permeate flow from the first-stage permeate outlet into the preliminary-stage inlet on the retentate side of the preliminary-stage chamber.

5. The serial filtration system of claim 4, further comprising:

a second-stage reverse-osmosis module, comprising:

(a) a second-stage chamber including a second-stage inlet, a second-stage retentate outlet, and a second-stage permeate outlet, wherein the second-stage inlet is in fluid communication with the first-stage retentate outlet;

(b) at least one second-stage oxidized membrane, comprising an oxidized polyamide active layer coated on a porous support, wherein the oxidized polyamide active layer has an atomic oxygen/nitrogen ratio of at least 1.5:1, and wherein the at least one second-stage oxidized membrane is mounted in the second-stage chamber and separates the second-stage chamber into a retentate side, including the second-stage inlet and the second-stage retentate outlet, on an upstream side of the at least one second-stage oxidized membrane and a permeate side, including the second-stage permeate outlet, on a downstream side of the at least one second-stage oxidized membrane; and

a second-stage-inlet passage providing fluid communication between the first-stage retentate outlet and the second-stage inlet and configured to direct retentate from the retentate side of the first-stage chamber through the at least one second-stage oxidized membrane in the second-stage chamber.

6. The serial filtration system of claim 5, further comprising:

a preliminary-stage pump positioned upstream from the preliminary-stage inlet and configured to pump and pressurize feed liquid fed through the preliminary-stage inlet to pass solvent in the feed liquid from the retentate side of the preliminary-stage chamber through the at least one preliminary-stage reverse-osmosis membrane into the permeate side of the preliminary-stage chamber; and

a second-stage pump positioned downstream from the second-stage permeate outlet and configured to pump and pressurize second-stage permeate liquid from the permeate side of the second-stage chamber into the retentate side of the first-stage chamber and to pass solvent from the second-stage permeate liquid through the at least one first-stage oxidized membrane into the permeate side of the first-stage chamber.

7. The serial filtration system of claim 5, wherein the surface area of the at least one first-stage oxidized membrane differs from a surface area of the at least one second-stage oxidized membrane.

8. The serial filtration system of claim 5, further comprising a second-stage-permeate-outlet passage configured to provide second-stage permeate flow from the second-stage permeate outlet into the first-stage inlet on the retentate side of the first-stage chamber.

9. The serial filtration system of claim 5, wherein the oxidized polyamide active layer of the at least one second-stage oxidized membrane includes chlorine at a concentration of 1-10 atomic percent.

10. The serial filtration system of claim 5, wherein the oxidized polyamide active layer of the at least one second-stage oxidized membrane is formed by exposing the polyamide active layer to a sodium-hypochlorite solution at a concentration-time in a range from 5,000 to 50,000 parts per million × hours.

11. The serial filtration system of claim 1, wherein the porous support of the at least one first-stage oxidized membrane comprises a porous layer comprising at least one of polyethersulfone and polysulfone on a non-woven fabric support sheet.

12. A method for serial filtration, comprising:

utilizing the serial filtration system, as described in claim 1;

feeding a feed liquid comprising a solvent and dissolved ions through the preliminary-stage inlet into the preliminary-stage chamber and establishing a pressure on the retentate side of the at least one preliminary-stage reverse-osmosis module that is greater than a pressure on the permeate side of the preliminary-stage chamber;

selectively passing a solvent in a preliminary-stage permeate from the retentate side of the preliminary-stage chamber through the at least one preliminary-stage reverse-osmosis membrane into the permeate side of the preliminary-stage chamber while retaining a preliminary-stage retentate brine with an increased concentration of the dissolved ions on the retentate side of the preliminary-stage chamber;

removing the preliminary-stage retentate brine through the preliminary-stage retentate outlet and then directing the preliminary-stage retentate brine through the first-stage inlet into the first-stage chamber and establishing a pressure in the retentate side of the first-stage chamber that is greater than a pressure in the permeate side of the first-stage chamber; and

selectively passing a solvent in a first-stage permeate from the retentate side of the first-stage chamber through the at least one first-stage oxidized membrane into the permeate side of the first-stage chamber while retaining a first-stage retentate brine with a further-increased concentration of the dissolved ions on the retentate side of the first-stage chamber.

13. The method of claim 12, further comprising directing the first-stage permeate through the first-stage permeate outlet and back through the preliminary-stage inlet of the retentate side of the preliminary-stage chamber along with the feed liquid.

14. The method of claim 12, further comprising removing the first-stage retentate brine from the retentate side of the first-stage chamber through the first-stage retentate outlet and then directing the first-stage retentate brine though a second-stage inlet into a second-stage chamber of a second-stage reverse-osmosis module that further includes at least one second-stage oxidized membrane that separates the second-stage chamber into a retentate side and a permeate side and establishing a pressure in the retentate side of the second-stage chamber that is greater than a pressure in the permeate side of the second-stage chamber.

15. The method of claim 12, wherein the oxidized polyamide active layer of the at least one first-stage oxidized membrane is a partially oxidized polyamide layer, and wherein the partially oxidized polyamide layer is formed by exposing a polyamide layer to an oxidant to create controlled porosity in the polyamide layer, the method further comprising:

after extended practice of the method of claim 12, subjecting the at least one first-stage oxidized membrane to an oxidation adjustment step, comprising exposing the at least one first-stage oxidized membrane to the oxidant to adjust the controlled porosity in the partially oxidized polyamide layer; and

resuming practice of the method of claim 12 after performing the oxidation adjustment step.

16. The method of claim 12, further comprising introducing an ion-rejection-enhancement agent to the retentate side of the at least one first-stage oxidized membrane, wherein the ion-rejection-enhancement agent reduces the permeability of the at least one first-stage oxidized membrane.

17. The method of claim 16, wherein the ion-rejection-enhancement agent comprises at least one composition selected from polyvinyl methyl ether, polyvinyl pyrrolidone, polyvinyl alcohol, and tannic acid.

18. A method for fabricating an oxidized membrane for reverse osmosis, comprising:

providing a reverse-osmosis membrane comprising a polyamide active layer coated on a porous support; and

exposing the polyamide active layer to a sodium-hypochlorite solution to create an oxidized polyamide active layer having an atomic oxygen/nitrogen ratio of at least 1.5:1, wherein the polyamide active layer is exposed to the sodium-hypochlorite solution at a concentration-time in a range from 5,000 to 50,000 parts per million $\times$hours.

19. The method of claim 18, wherein the oxidized polyamide active layer includes chlorine at a concentration of 1-10 atomic percent.

20. The method of claim 18, wherein the porous support of the at least one first-stage oxidized membrane comprises a porous layer comprising at least one of polyethersulfone and polysulfone on a non-woven fabric support sheet.

21. The method of claim 18, further comprising applying an ion-rejection-enhancement agent to the reverse-osmosis membrane, wherein the ion-rejection-enhancement agent reduces the permeability of the reverse-osmosis membrane.

22. The method of claim 21, wherein the ion-rejection-enhancement agent comprises at least one composition selected from polyvinyl methyl ether, polyvinyl pyrrolidone, polyvinyl alcohol, and tannic acid.