WHAT IS CLAIMED IS:

1. A supercapacitor, comprising:

a first electrode;

a second electrode;

a first ionic carrier configured to contact the first electrode to provide a first ion-conductive pathway for transportation of ions to and from the first electrode;

a first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

an electrolyte dispersed between the first and the second electrodes to provide the ions;

a first current collector configured to contact the first electrode; and

a second current collector configured to contact the second electrode.

2. The supercapacitor of claim 1, comprising a second ionic carrier and a second retaining layer, the second ionic carrier is configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the second electrode, and the second retaining layer is configured to retain the second ionic carrier between the second electrode and the second retaining layer.

3. The supercapacitor of claim 2, wherein the first ionic carrier comprises a first polyelectrolyte and the second ionic carrier comprises a second polyelectrolyte.

4. The supercapacitor of claim 3, wherein the first ionic carrier comprises poly(diallydimethyl ammonium chloride) solution and the second ionic carrier comprises polystyrene sulfate sodium solution.

5. The supercapacitor of claim 2, wherein the first and second retaining layers comprise ion exchange membranes and are configured to protect the respective first and second ionic carrier from losing effectiveness.

6. The supercapacitor of claim 5, wherein the first and second pathways are configured to reduce resistance between the respective electrodes and the retaining layers.

7. The supercapacitor of claim 5, wherein the first retaining layer is only passable for anions and the second retaining layer is only passable for cations.

8. The supercapacitor of claim 2, further comprising a spacer disposed between the first and second retaining layers.

9. A supercapacitor desalination cell, comprising:

a first electrode configured to adsorb ions in a charging state of the cell and desorb ions in a discharging state of the cell;

a second electrode configured to adsorb the ions in a charging state of the cell and desorb ions in a discharging state of the cell;

a first ionic carrier configured to contact the first electrode to provide a first ion-conductive pathway for transportation of the ions to and from the first electrode;

a first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

a first current collector configured to contact the first electrode; and

a second current collector configured to contact the second electrode.

10. The supercapacitor desalination cell of claim 9, wherein the first ionic carrier comprises a macromolecular ampholyte.

11. The supercapacitor desalination cell of claim 9, comprising a second ionic carrier and a second retaining layer, the second ionic carrier is

configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the second electrode, the second retaining layer is configured to retain the second ionic carrier between the second electrode and the second retaining layer.

12. The supercapacitor desalination cell of claim 11, wherein the first and second pathways are to reduce resistance between the respective electrodes and the retaining layers.

13. The supercapacitor desalination cell of claim 11, further comprising a spacer disposed between the first and second retaining layers.

14. The supercapacitor desalination cell of claim 11, wherein the first ionic carrier comprises a first polyelectrolyte and the second ionic carrier comprises a second polyelectrolyte.

15. The supercapacitor desalination cell of claim 14, wherein the first polyelectrolyte comprises cation groups and the second polyelectrolyte comprises anion groups.

16. The supercapacitor desalination cell of claim 15, wherein the first polyelectrolyte comprises poly(diallydimethyl ammonium chloride) and the second polyelectrolyte comprises polystyrene sulfate sodium.

17. The supercapacitor desalination cell of claim 11, wherein the first and second retaining layers comprise ion exchange membranes and are configure to protect the respective first and second ionic carrier from losing effectiveness.

18. The supercapacitor desalination cell of claim 17, wherein the first retaining layer is only passable for anions and the second retaining layer is only passable for cations.

19. The supercapacitor desalination cell of claim 11, wherein the first and the second ionic carriers are in a solution form.

20. The supercapacitor desalination cell of claim 11, wherein the first and second ionic carrier are in a gel form.

21. A supercapacitor desalination device, comprising:

a supercapacitor desalination cell comprising a first electrode and a second electrode both configured to adsorb ions in a charging state of the cell and desorb ions in a discharging state of the cell, a first ionic carrier configured to contact the first electrode to provide a first ion-conductive pathway for transportation of the ions to and from the first electrode, a first retaining layer configured to retain the second ionic carrier between the second electrode and the second retaining layer, a first and a second current collectors configured to contact the first electrode and the second electrode, respectively;

a power source configured to energize the first and the second electrodes to opposite electrical polarities; and

a liquid source configured to pass a liquid through the cell for desalination.

22. The supercapacitor desalination device of claim 21, wherein the supercapacitor desalination cell further comprises a second ionic carrier and a second retaining layer, the second ionic carrier is configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the second electrode, the second retaining layer is configured to retain the second ionic carrier between the second electrode and the second retaining layer.

23. The supercapacitor desalination device of claim 22, wherein the supercapacitor desalination cell further comprises a spacer disposed between the first and second retaining layers.

24. The supercapacitor desalination device of claim 22, wherein the first ionic carrier comprises a first polyelectrolyte solution and the second ionic carrier comprises a second polyelectrolyte solution.

25. The supercapacitor desalination device of claim 24, wherein the first ionic carrier comprises poly(diallydimethyl ammonium chloride) and the second ionic carrier comprises polystyrene sulfate sodium.

26. A method, comprising:

providing a first electrode and a second electrode;

providing a first ionic carrier configured to contact the first electrode to provide a first ion-conductive pathway for transportation of ions to and from the first electrode;

providing a first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

providing a first current collector configured to contact the first electrode; and

providing a second current collector configured to contact the second electrode.

27. The method of claim 26, comprising providing a second ionic carrier configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the first electrode, and a second retaining layer configured to retain the second ionic carrier between the second electrode and the second retaining layer.

28. The method of claim 27, further comprising providing a spacer disposed between the first and second retaining layers.

29. The method of claim 28, wherein the first ionic carrier comprises poly(diallydimethyl ammonium chloride) solution and the second ionic carrier comprises polystyrene sulfate sodium solution.

CLAIMS

1. A supercapacitor, comprising:

a first electrode;

a second electrode;

a first ionic carrier comprising a first polyelectrolyte and configured to contact the first electrode to provide a first ion-conductive pathway for transportation of ions to and from the first electrode;

an electrolyte dispersed between the first and the second electrodes to provide the ions;

a first retaining layer passable for ions traveling towards the first electrode from the electrolyte contacting the first retaining layer but not passable to the first polyelectrolyte, the first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

a first current collector configured to contact the first electrode; and

a second current collector configured to contact the second electrode.

2. The supercapacitor of claim 1, comprising a second ionic carrier comprising a second polyelectrolyte and a second retaining layer passable for ions traveling to the second electrode from the electrolyte contacting the second retaining layer but not passable to the second polyelectrolyte, the second ionic carrier is configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the second electrode, and the second retaining layer is configured to retain the second ionic carrier between the second electrode and the second retaining layer.

3. The supercapacitor of claim 2, wherein the first polyelectrolyte comprises poly(diallyldimethyl ammonium chloride) and the second polyelectrolyte comprises polystyrene sulfate sodium.

4. The supercapacitor of claim 2, wherein the first and second retaining layers comprise ion exchange membranes and are configured to protect the respective first and second ionic carrier from losing effectiveness.

5. The supercapacitor of claim 4, wherein the first and second pathways are configured to reduce resistance between the respective electrodes and the retaining layers.

6. The supercapacitor of claim 4, wherein the first retaining layer is only passable for anions and the second retaining layer is only passable for cations.

7. The supercapacitor of claim 2, further comprising a spacer disposed between the first and second retaining layers.

8. The supercapacitor of claim 1 wherein the first ionic carrier is in a gel form or a solution form.

9. A supercapacitor desalination cell, comprising:

a first electrode configured to adsorb ions in a charging state of the cell and desorb ions in a discharging state of the cell;

a second electrode configured to adsorb the ions in a charging state of the cell and desorb ions in a discharging state of the cell;

a first ionic carrier comprising a first polyelectrolyte and configured to contact the first electrode to provide a first ion-conductive pathway for transportation of the ions to and from the first electrode;

a first retaining layer passable for ions traveling towards the first electrode from an electrolyte contacting the first retaining layer but not passable to the first polyelectrolyte, the first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

a first current collector configured to contact the first electrode; and

a second current collector configured to contact the second electrode.

10. The supercapacitor desalination cell of claim 9, wherein the first polyelectrolyte comprises a macromolecular ampholyte.

11. The supercapacitor desalination cell of claim 9, comprising a second ionic carrier comprising a second polyelectrolyte and a second retaining layer passable for

ions traveling to the second electrode from an electrolyte contacting the second retaining layer but not passable to the second polyelectrolyte, the second ionic carrier is configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the second electrode, the second retaining layer is configured to retain the second ionic carrier between the second electrode and the second retaining layer.

12. The supercapacitor desalination cell of claim 11, wherein the first and second pathways are to reduce resistance between the respective electrodes and the retaining layers.

13. The supercapacitor desalination cell of claim 11, further comprising a spacer disposed between the first and second retaining layers.

14. The supercapacitor desalination cell of claim 11, wherein the first polyelectrolyte comprises cation groups and the second polyelectrolyte comprises anion groups.

15. The supercapacitor desalination cell of claim 14, wherein the first polyelectrolyte comprises poly(diallyldimethyl ammonium chloride) and the second polyelectrolyte comprises polystyrene sulfate sodium.

16. The supercapacitor desalination cell of claim 11, wherein the first and second retaining layers comprise ion exchange membranes and are configured to protect the respective first and second ionic carrier from losing effectiveness.

17. The supercapacitor desalination cell of claim 16, wherein the first retaining layer is only passable for anions and the second retaining layer is only passable for cations.

18. The supercapacitor desalination cell of claim 11, wherein the first and the second ionic carriers are in a solution form.

19. The supercapacitor desalination cell of claim 11, wherein the first and second ionic carrier are in a gel form.

20. The supercapacitor of claim 9 wherein the first ionic carrier is in a gel form or a solution form.

21. A supercapacitor desalination device, comprising:

a supercapacitor desalination cell comprising a first electrode and a second electrode both configured to adsorb ions in a charging state of the cell and desorb ions in a discharging state of the cell, a first ionic carrier comprising a first polyelectrolyte and configured to contact the first electrode to provide a first ion-conductive pathway for transportation of the ions to and from the first electrode, a first retaining layer passable for ions traveling towards the first electrode from an electrolyte contacting the first retaining layer but not passable to the first polyelectrolyte, the first retaining layer configured to retain the second ionic carrier between the second electrode and the second retaining layer, a first and a second current collectors configured to contact the first electrode and the second electrode, respectively;

a power source configured to energize the first and the second electrodes to opposite electrical polarities; and

a liquid source configured to pass a liquid through the cell for desalination.

22. The supercapacitor desalination device of claim 21, wherein the supercapacitor desalination cell further comprises a second ionic carrier comprising a second polyelectrolyte and a second retaining layer passable for ions traveling to the second electrode from an electrolyte contacting the second retaining layer but not passable to the second polyelectrolyte, the second ionic carrier is configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the second electrode, the second retaining layer is configured to retain the second ionic carrier between the second electrode and the second retaining layer.

23. The supercapacitor desalination device of claim 22, wherein the supercapacitor desalination cell further comprises a spacer disposed between the first and second retaining layers.

24. The supercapacitor desalination device of claim 22, wherein the first polyelectrolyte comprises poly(diallyldimethyl ammonium chloride) and the second polyelectrolyte comprises polystyrene sulfate sodium.

25. The supercapacitor of claim 21 wherein the first ionic carrier is in a gel form or a solution form.

26. A method, comprising:

providing a first electrode and a second electrode;

providing a first ionic carrier comprising a first polyelectrolyte and configured to contact the first electrode to provide a first ion-conductive pathway for transportation of ions to and from the first electrode;

providing a first retaining layer passable for ions traveling towards the first electrode from an electrolyte contacting the first retaining layer but not passable to the first polyelectrolyte, the first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

providing a first current collector configured to contact the first electrode; and

providing a second current collector configured to contact the second electrode.

27. The method of claim 26, comprising providing a second ionic carrier comprising a second polyelectrolyte and configured to contact the second electrode to provide a second ion-conductive pathway for transportation of the ions to and from the first electrode, and a second retaining layer passable for ions traveling towards the second electrode from an electrolyte contacting the second retaining layer but not passable to the second polyelectrolyte, the second retaining layer configured to retain the second ionic carrier between the second electrode and the second retaining layer.

28. The method of claim 27, further comprising providing a spacer disposed between the first and second retaining layers.

29. The method of claim 28, wherein the first polyelectrolyte comprises poly(diallyldimethyl ammonium chloride) solution and the second polyelectrolyte comprises polystyrene sulfate sodium solution.

30. The method of claim 26 wherein the step of providing the first ionic carrier comprises contacting the first electrode with the ionic carrier in a solution form or by polymerizing or cross-linking the ionic carrier in contact with the first electrode.

31. A supercapacitor, comprising:

a first electrode;

a second electrode;

a first ionic carrier, in a gel form or a solution form, configured to contact the first electrode to provide a first ion-conductive pathway for transportation of ions to and from the first electrode;

a first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

an electrolyte dispersed between the first and the second electrodes to provide the ions;

a first current collector configured to contact the first electrode; and

a second current collector configured to contact the second electrode.

32. A supercapacitor desalination cell, comprising:

a first electrode configured to adsorb ions in a charging state of the cell and desorb ions in a discharging state of the cell;

a second electrode configured to adsorb the ions in a charging state of the cell and desorb ions in a discharging state of the cell;

a first ionic carrier, in a gel form or a solution form, configured to contact the first electrode to provide a first ion-conductive pathway for transportation of the ions to and from the first electrode;

a first retaining layer configured to retain the first ionic carrier between the first electrode and the first retaining layer;

a first current collector configured to contact the first electrode; and

a second current collector configured to contact the second electrode.

33. A supercapacitor desalination device, comprising:

a supercapacitor desalination cell comprising a first electrode and a second electrode both configured to adsorb ions in a charging state of the cell and desorb ions in a discharging state of the cell, a first ionic carrier, in a gel form or a solution form, configured to contact the first electrode to provide a first ion-conductive pathway for transportation of the ions to and from the first electrode, a first retaining layer configured to retain the second ionic carrier between the second electrode and the

second retaining layer, a first and a second current collectors configured to contact the first electrode and the second electrode, respectively;

a power source configured to energize the first and the second electrodes to opposite electrical polarities; and

a liquid source configured to pass a liquid through the cell for desalination.