CLAIMS

1. A battery comprising:

an anode comprising a first electrochemically active material;

a cathode comprising both a second electrochemically active material and a first electrolyte;

a second electrolyte interposed between the anode and the cathode;

wherein at least one of the first electrolyte and second electrolyte comprises a solid polymer electrolyte;

wherein the solid polymer electrolyte has an ionic conductivity greater than 1×10^{-4} S/cm at room temperature, and comprises both at least one cationic and anionic diffusing ion, wherein at least one cationic diffusing ion comprises lithium and wherein at least one diffusing ion is mobile at room temperature.

2. The battery of claim 1, wherein the solid polymer electrolyte comprises:

a crystallinity greater than 30%.

3. The battery of claim 1, wherein the solid polymer electrolyte is less than 1×10^{-8} S/cm at room temperature.

4. The battery of claim 1, wherein the solid polymer electrolyte comprises:

a plurality of monomers;

a plurality of charge transfer complexes, wherein each charge transfer complex is positioned on a monomer;

where the electronic conductivity of the solid polymer electrolyte is less than 1×10^{-8} S/cm at room temperature.

5. The battery of claims 1, wherein the solid polymer electrolyte has a glassy at room temperature.

6. The battery of claim 1, wherein the melting temperature of the solid polymer electrolyte is greater than 250°C.

7. The battery of claim 1, wherein the solid polymer electrolyte is a thermoplastic.

8. The battery of claim 13, wherein the ionic conductivity of the solid polymer electrolyte is isotropic.

9. The battery of claim 1, wherein the Young's modulus of the solid polymer electrolyte is equal to or greater than 3.0 MPa.

10. The battery of claim 1, wherein the solid polymer electrolyte has an ionic conductivity greater than 1×10^{-3} S/cm at 80°C.

11. The battery of claim 1, wherein the solid polymer electrolyte has an ionic conductivity greater than 1×10^{-5} S/cm at -40°C.

12. The battery of claim 1, wherein the cationic transference number of the solid polymer electrolyte is greater than 0.5 and less than 1.0.

13. The battery of claim 2, wherein at least one anionic diffusing ion comprises fluorine or boron.

14. The battery of claim 1, wherein there is at least one mole of the lithium per liter of solid polymer electrolyte.

15. The battery of claim 1, wherein both the first and second electrolyte comprise the solid polymer electrolyte, wherein the electronic conductivity of the second electrolyte is less than 1×10^{-8} S/cm at room temperature.

16. The battery of claim 1, wherein the anode comprises a third electrolyte, and wherein the third electrolyte comprises the solid polymer electrolyte.

17. The battery of claim 2, wherein the second electrochemically active material comprises a lithium oxide comprising nickel, cobalt or manganese.

18. The battery of claim 1, wherein the second electrochemically active material comprises a lithium oxide or a lithium phosphate that contain a metal selected from a group consisting of ss nickel, cobalt or manganese.

19. The battery of claim 1, wherein the second electrochemically active material comprises a lithium intercalation material, wherein the lithium intercalation material comprises lithium.

20. The battery of claim 19, wherein the lithium intercalation material is selected from a group consisting of Lithium Nickel Cobalt Aluminum Oxide; Lithium Nickel Cobalt Manganese Oxide; Lithium Iron Phosphate; Lithium Manganese Oxide; Lithium cobalt phosphate or lithium manganese nickel oxide, Lithium Cobalt Oxide, $LiTiS_2$, $LiNiO_2$, or combinations thereof.

21. The battery of claim 1, wherein the second electrochemically active material comprises an electrochemically active cathode compound that reacts with lithium in a solid state redox reaction.

22. The battery of claim 65, wherein the lithium intercalation material comprises Lithium Nickel Cobalt Manganese Oxide, wherein the atomic concentration of nickel in the Lithium Nickel Cobalt Manganese Oxide is greater than the atomic concentration of cobalt or manganese.

23. The battery of claim 1, wherein the first electrochemically active material comprises an intercalation material.

24. The battery of claim 1, wherein the first electrochemically active material comprises lithium metal.

25. The battery of claim 1, further comprising an anode current collector in electronix communication with the anode, wherein lithium deposits on the anode current collector when the battery is charged.

26. The battery of claim 72, wherein the density of the lithium deposited on the anode current collector is greater than 0.4 g/cc.

27. The battery of claim 69, wherein the first electrochemically active material comprises Silicon, Tin, antimony, lead, Cobalt, Iron, Titanium, Nickel, magnesium, aluminum, gallium, Germanium, phosphorus, arsenic, bismuth, zinc, carbon and mixtures thereof.

28. The battery of claim 1, wherein the charged voltage of the battery is greater than 4.1 volts.

29. The battery of claim 1, wherein the charged voltage of the battery is greater than 4.5 volts.

30. The battery of claim 1, wherein the charged voltage of the battery is greater than 5.0 volts.

31. The battery of claim 1, wherein the second electrolyte comprises the solid polymer electrolyte, and wherein the first electrolyte comprises the solid polymer electrolyte, and whereby the second electrolyte is attached to and in ionic communication with the cathode.

32. The battery of claim 1, wherein the second electrolyte comprises the solid polymer electrolyte, and wherein the anode comprises a third electrolyte, and wherein the third electrolyte comprises the solid polymer electrolyte, whereby the second electrolyte is attached to and in ionic communication with the anode.