~~What is claimed is:~~

CLAIMS

1. A flow battery comprising:

at least one rechargeable cell including

an anolyte compartment configured to hold a first electrolyte having a first cation species;

a catholyte compartment configured to hold a second electrolyte having a second cation species; and

an anion exchange membrane positioned between the anolyte compartment and the catholyte compartment, configured to be ionically conductive between the first electrolyte and the second electrolyte, the anion exchange membrane having a thickness of less than 100 μm and a steady state diffusivity of less than 0.4 ppm/hr/cm^2 with respect to at least one of the first cation species and the second cation species~~.~~

~~2. The flow battery of claim 1, wherein at least one of the first cation species and the second cation species is a metal ion.~~

~~3. The flow battery of claim 2, wherein at least one of the first cation species and the second cation species is selected from zinc, copper, cerium, and vanadium.~~

~~4. The flow battery of claim 3, wherein the anion exchange membrane has a useful life of at least about 12 weeks, determined when internal potential drop is at least about 2.5 V.~~

~~5. The flow battery of claim 1~~, wherein the anion exchange membrane has a thickness of less than about 55 μm~~.~~

~~6. The flow battery of claim 5~~, wherein the anion exchange membrane has a thickness of between about 15 μm and about 35 μm~~.~~

~~7. The flow battery of claim 6~~, wherein the anion exchange membrane has a thickness of about 25 μm.

8. The flow battery of claim 7, wherein the anion exchange membrane has a steady state diffusivity of less than 0.12 ppm/hr/cm^2 with respect to at least one of the first cation species and the second cation species.

9. The flow battery of claim 1, wherein the anion exchange membrane has a resistance of between about 3.0 Ω-cm^2 and about 10.0 Ω-cm^2 when measured on direct current after equilibrium in a 0.5M NaCl solution at 25° C.

10. The flow battery of claim 9, wherein the anion exchange membrane has a resistance of between about 5.0 Ω-cm^2 and about 8.0 Ω-cm^2 when measured on direct current after equilibrium in a 0.5M NaCl solution at 25° C.

11. The flow battery of claim 10, wherein the anion exchange membrane has a co-ion transport number of at least about 0.95 with respect to at least one non-redox species.

12. The flow battery of claim 1, configured to be compatible with a high voltage direct current (HVDC) transmission line and provide a voltage of between about 1000V and about 800KV.

13. The flow battery of claim 1, configured to be compatible with an automobile and provide a voltage of between about 100V and about 500V.

14. A method of facilitating use of a flow battery, comprising:

providing at least one anion exchange membrane having a thickness of less than 100 μm and a steady state diffusivity of less than 0.4 ppm/hr/cm^2 with respect to at least one of a first metal cation species and a second metal cation species; and

providing instructions to install each anion exchange membrane in a rechargeable cell of the flow battery, between an anolyte compartment and a catholyte compartment.

15. The method of claim 14, wherein providing the anion exchange membrane comprises providing an anion exchange membrane having a thickness of between about 15 μm and about 35 μm.

16. The method of claim 15, wherein providing the anion exchange membrane comprises providing an anion exchange membrane having a steady state diffusivity of less than 0.12 ppm/hr/cm^2 with respect to at least one of the first metal cation species and the second metal cation species, the first and second metal cation species independently selected from zinc, copper, cerium, and vanadium.

17. The method of claim 16, further comprising providing instructions to charge the flow battery and continuously operate the flow battery.

18. A method of facilitating storage of an electric charge, comprising:

providing a flow battery comprising a plurality of rechargeable cells, each rechargeable cell including:

an anolyte compartment configured to hold a first electrolyte having a first cation species;

a catholyte compartment configured to hold a second electrolyte having a second cation species; and

an anion exchange membrane positioned between the anolyte compartment and the catholyte compartment, configured to be ionically conductive between the first electrolyte and the second electrolyte, the anion exchange membrane having a thickness of less than 100 μm and a steady state diffusivity of less than 0.4 ppm/hr/cm^2 with respect to at least one of the first cation species and the second cation species; and

providing instructions to charge the flow battery.

19. The method of claim 18, further comprising providing instructions to charge the flow battery by electrically connecting the flow battery to a variable energy supply

20. The method of claim 18, further comprising providing instructions to electrically connect the flow battery to a high voltage direct current (HVDC) transmission line.

21. The method of claim 20, further comprising providing instructions to replace at least one of the first electrolyte and the second electrolyte after discharge of the flow battery.

~~22. A method of producing an anion exchange membrane, comprising:~~

~~integrating a cationic functional monomer having a cross-linking group in a polymerization product being substantially free of a cross-linking agent; and~~

~~coating a microporous substrate having a thickness of less than about 100 μm with the polymerization product.~~

~~23. The method of claim 22, wherein the microporous substrate has a thickness of about 25 μm.~~

~~24. The method of claim 25, wherein the microporous substrate comprises at least one of polypropylene, high molecular weight polyethylene, ultrahigh molecular weight polyethylene, polyvinyl chloride, polyvinylidene fluoride, polysulfone, and combinations thereof.~~

~~25. The method of claim 24, wherein the microporous substrate has a porosity of between about 25% and about 45% and an average pore size of between about 50 nm and about 10 μm.~~

~~26. The method of claim 25, wherein the microporous substrate comprises ultrahigh molecular weight polyethylene having a porosity of about 35% and an average pore size of about 200 nm.~~