Claims

1. An electrolyte comprising:
   a) at least one magnesium salt;
   b) an aluminium halide salt; and
   c) a solvent comprising at least one ether group;
   wherein the electrolyte does not comprise magnesium chloride; ~~and~~
   wherein said at least one magnesium salt comprises a polyatomic anion selected from the group consisting of chlorate, trifluoromethanesulfonate (OTf), phosphate, sulfate, sulfite, hexafluorophosphate, hexafluoroarsenate, bis(trifluoromethanesulfonyl)imide (TFSI), bis(fluorosulfonyl)imide (FSI), bis(butanesulfonyl) imide, cyanamide, oligomeric fluorosulfonyl imide, nonafluorobutanesulfonyl imide, bis(oxalato)borate (BOB), difluoro(oxalato)borate (DFOB), and tetrafluoroborate; and
   wherein the molar ratio of the magnesium cation of the magnesium salt to the halide anion of the aluminium halide salt is from 1:3 to 1:5.

~~2. An electrolyte consisting essentially of:~~
~~a) a magnesium salt;~~
~~b) an aluminium halide salt; and~~
~~c) a solvent comprising at least one ether group;~~
~~wherein said magnesium salt comprises a polyatomic anion.~~

~~3.~~2. The electrolyte of any of the preceding claims, wherein the aluminium halide salt is aluminium fluoride, aluminium chloride, aluminium bromide or aluminium iodide.

~~4.~~3. The electrolyte of any of the preceding claims, wherein the aluminium halide salt is aluminium chloride.

~~5.~~4. The electrolyte of any of the preceding claims, wherein the electrolyte comprises at least two or more magnesium salts.

~~6. The electrolyte of any of the preceding claims, wherein the polyatomic anion of the magnesium salt is chlorate, trifluoromethanesulfonate (OTf), phosphate, sulfate, sulfite, hexafluorophosphate, hexafluoroarsenate, bis(trifluoromethanesulfonyl)imide (TFSI), bis(fluorosulfonyl)imide (FSI), bis(butanesulfonyl) imide, cyanamide, oligomeric fluorosulfonyl imide, nonafluorobutanesulfonyl imide, bis(oxalato)borate (BOB), difluoro(oxalato)borate (DFOB), or tetrafluoroborate.~~

~~7.~~5. The electrolyte of any of the preceding claims, wherein the polyatomic anion of said magnesium salt is bis(trifluoromethanesulfonyl)imide.

~~8.~~6. The electrolyte of any of the preceding claims, wherein the solvent comprises less than 200 ppm water.

~~9.~~7. The electrolyte of any of the preceding claims, wherein the solvent comprises less than 20 ppm water.

~~10.~~8. The electrolyte of any of the preceding claims, wherein the concentration of the magnesium salt is between 0.01 M to 20 M.

~~11.~~9. The electrolyte of any of the preceding claims, wherein the concentration of the magnesium salt is between ~~between~~ 0.2 M to 0.5 M.

~~12.~~10. The electrolyte of any of the preceding claims, wherein the concentration of the aluminium halide salt is between 0.01 M to 20 M.

~~13.~~11. The electrolyte of any of the preceding claims, wherein the concentration of the aluminium halide salt is between 0.2 M to 0.6 M.

~~14. The electrolyte of any of the preceding claims, wherein the molar ratio of the magnesium salt to the aluminium halide salt is between 5:1 to 1:10.~~

~~15.~~12. The electrolyte of any the preceding claims, wherein the molar ratio of the magnesium salt to the aluminium halide salt is about 1:1.32.

~~16.~~13. The electrolyte of any of the preceding claims, wherein the solvent is selected from the group consisting of tetrahydrofuran, monoglyme, diglyme, triglyme, tetraglyme, dioxane, tetrahydropyran and combinations thereof.

~~17.~~14. The electrolyte of any of the preceding claims, wherein the solvent is monoglyme.

~~18.~~15. An electrochemical cell comprising:

a) a positive electrode;

b) a magnesium negative electrode;

c) the electrolyte of any of claims 1-14~~16~~; and

wherein said positive electrode and said magnesium negative electrode are in fluid communication with said electrolyte.

~~19.~~16. The electrochemical cell of claim ~~17~~15, wherein the electrolyte is absorbed on a separator located between said positive electrode and said magnesium negative electrode.

~~20.~~17. The electrochemical cell of any one of claims 15-16~~17-18~~, wherein the positive electrode is fabricated from a sulfur composite or a complex comprising a transition metal.