Claims

1. An electric device, comprising an electrolyte comprising:

a solvent;

a first quaternary ammonium or phosphonium salt; and

a second quaternary ammonium or phosphonium salt, containing an ammonium group having a general formula $[NR^1R^2R^3R^4]^+$, or a phosphonium group having a general formula $[PR^1R^2R^3R^4]^+$, wherein $R^1 = R^2$, $R^3 = R^4$, $R^2 \neq R^3$, and each R^1, R^2, R^3 and R^4 independently is a branched or unbranched alkyl group containing from 1 to about 20 carbon atoms, and

wherein each salt comprises an anion, and wherein the first and second ammonium or phosphonium are not the same.

2. The electric device of claim 1 wherein the first quaternary ammonium or phosphonium salt contains an ammonium group having a general formula $[NR^5(R^6)_3]^+$, or a phosphonium group having a general formula $[PR^5(R^6)_3]^+$, wherein $R^5 \neq R^6$, and each R^5 and R^6 independently is a branched or unbranched alkyl group containing from 1 to about 20 carbon atoms.

3. The electric device of either of claim 1 or claim 2 wherein the anion comprises one or a combination of two or more of BF_4^-, PF_6^-, AsF_6^-, SbF_6^-, BARF, BOB, FOB, BSB, tetrakis(pentafluorophenyl)borate ($B(C_6F_5)_4^-$), $Al(OC(CF_3)_3)_4^-$, maleate, phthalate, ClO_4^-, trifluoromethanesulfonate and alkyl trifluoromethanesulfonate.

4. The electric device of any one of claims 1-3 wherein the first quaternary ammonium salt is methyltriethyl ammonium BF4 (MTEABF4) and the second quaternary ammonium salt is dimethyldipropyl ammonium BF4 (DMDPABF4).

5. The electric device of claim 4 wherein the DMDPABF4 is at a concentration in the range from about 0.5 M to about 1.0 M, and the MTEABF4 is at a concentration in the range from about 1 M to about 2 M, or the DMDPABF4 is at a concentration in the range from about 0.65 M to about 0.85 M, and the MTEABF4 is at a concentration in the range from about 1.25 M to about 1.75 M, or the DMDPABF4 is at a concentration of about 0.75 M, and the MTEABF4 is at a concentration of about 1.5 M.

6. The electric device of any one of claims 1-3 wherein the ammonium or phosphonium of the second quaternary ammonium or phosphonium salt is one or a combination of any two or more of dimethyldiethyl, dimethyldipropyl, dimethyldibutyl, dimethyldipentyl, dimethyldihexyl, diethyldipropyl, diethyldibutyl, diethyldipentyl and diethyldihexyl ammonium or phosphonium.

7. The electric device of any preceding claim wherein the solvent is selected from propylene carbonate, dimethylsulfoxide, N, N dimethylformamide, ethylene carbonate, dimethyl carbonate, diethyl carbonate, acetonitrile, sulfolane and γ-butyrolactone.

8. The electric device of any preceding claim wherein the electric device is a capacitor, supercapacitor, electrochemical capacitor, electrolytic capacitor, battery, fuel cell, sensor, electrochromic device, photoelectrochemical solar cell, light-emitting electrochemical cell, polymer light emitting diode (PLED), electrophoretic display, polymer light-emitting electrochemical cell (PLEC), a magnesium-ion battery, a lithium-ion battery, an electrolytic capacitor, or an electric double-layer capacitor (ELDC).

9. The electric device of any preceding claim wherein the electric device is an electric double layer capacitor (ELDC).

10. An electrolyte comprising:

a solvent;

a first quaternary ammonium or phosphonium salt; and

a second quaternary ammonium or phosphonium salt, containing an ammonium group having a general formula $[NR^1R^2R^3R^4]^+$, or a phosphonium group having a general formula $[PR^1R^2R^3R^4]^+$, wherein $R^1 = R^2$, $R^3 = R^4$, $R^2 \neq R^3$, and each R^1, R^2, R^3 and R^4 independently is a branched or unbranched alkyl group containing from 1 to about 20 carbon atoms, and

wherein each salt comprises an anion, and wherein the first and second ammonium or phosphonium are not the same.

11. The electrolyte of claim 10 wherein the first quaternary ammonium or phosphonium salt contains an ammonium group having a general formula $[NR^5(R^6)_3]^+$, or a phosphonium group having a general formula $[PR^5(R^6)_3]^+$, wherein $R^5 \neq R^6$, and each R^5 and R^6 independently is a branched or unbranched alkyl group containing from 1 to about 20 carbon atoms.

12. The electrolyte of either of claim 10 or claim 11 wherein the comprises one or a combination of two or more of BF_4^-, PF_6^-, AsF_6^-, SbF_6^-, BARF, BOB, FOB, BSB, tetrakis(pentafluorophenyl)borate ($B(C_6F_5)_4^-$), $Al(OC(CF_3)_3)_4^-$, maleate, phthalate, ClO_4^-, trifluoromethanesulfonate and alkyl trifluoromethanesulfonate.

13. The electrolyte of any one of claims 10-12 wherein the first quaternary ammonium salt is methyltriethyl ammonium BF4 (MTEABF4) and the second quaternary ammonium salt is dimethyldipropyl ammonium BF4 (DMDPABF4).

14. The electrolyte of claim 13 wherein the DMDPABF4 is at a concentration in the range from about 0.5 M to about 1.0 M, and the MTEABF4 is at a concentration in the range from about 1 M to about 2 M, or the DMDPABF4 is at a concentration

in the range from about 0.65 M to about 0.85 M, and the MTEABF4 is at a concentration in the range from about 1.25 M to about 1.75 M, or the DMDPABF4 is at a concentration of about 0.75 M, and the MTEABF4 is at a concentration of about 1.5 M.

15. The electrolyte of any one of claims 10-12 wherein the ammonium ion of the second quaternary ammonium salt is one or a combination of any two or more of dimethyldiethyl, dimethyldipropyl, dimethyldibutyl, dimethyldipentyl, dimethyldihexyl, diethyldipropyl, diethyldibutyl, diethyldipentyl and diethyldihexyl ammonium.

16. The electrolyte of any one of claims 10-12 wherein the solvent is selected from propylene carbonate, dimethylsulfoxide, N, N dimethylformamide, ethylene carbonate, dimethyl carbonate, diethyl carbonate, acetonitrile, sulfolane and γ-butyrolactone.