CLAIMS:

1. A nonaqueous electrolyte solution for a lithium battery, which solution comprises

i) a liquid electrolyte medium;

ii) a lithium-containing salt; and

iii) at least one brominated flame retardant selected from

a) a brominated diazole having at least one bromine atom bound to a carbon atom of the diazole ring and a substituent on the N-H nitrogen atom of the diazole ring, and when the diazole is an imidazole, there are at least two bromine atoms bound to the diazole ring, or

b) a brominated triazole having one or two bromine atoms bound to carbon atoms of the triazole ring and a substituent on the N-H nitrogen atom of the triazole ring, the substituent being a hydrocarbyl group or an ether group, and when the triazole is a 1,2,4-triazole, there are either two bromine atoms bound to the carbon atoms of the triazole ring, or one bromine atom and one hydrogen atom bound to the carbon atoms of the triazole ring.

2. A nonaqueous electrolyte solution as in Claim 1 wherein the brominated flame retardant is

a brominated diazole which has four to about twelve carbon atoms, and/or a bromine content of about 30 wt% or more relative to the total weight of the brominated flame retardant; or

a brominated triazole which has two to about ten carbon atoms, and/or a bromine content of about 35 wt% to about 75 wt% relative to the total weight of the brominated flame retardant.

3. A nonaqueous electrolyte solution as in Claim 1 wherein the brominated flame retardant is

I) a brominated diazole in which the substituent bound to the N-H nitrogen atom of the diazole ring is selected from hydrocarbyl groups and ether groups; or

a brominated triazole in which the substituent bound to the N-H nitrogen atom of the triazole ring is selected from hydrocarbyl groups and ether groups; or

II) a brominated diazole in which the ether group contains one to about four oxygen atoms, wherein the linkage between the N-H nitrogen atom of the diazole ring and the ether oxygen atom is a saturated hydrocarbylene group, the ether group having an end portion that is a hydrocarbyl group having one to about four carbon atoms, and when there are two

or more oxygen atoms in the ether group, the linkage between the oxygen atoms is a saturated hydrocarbylene group; or

a brominated triazole in which the ether group contains one to about four oxygen atoms, wherein the linkage between the N-H nitrogen atom of the triazole ring and the ether oxygen atom is a saturated hydrocarbylene group, the ether group having an end portion that is a hydrocarbyl group having one to about four carbon atoms, and when there are two or more oxygen atoms in the ether group, the linkage between the oxygen atoms is a saturated hydrocarbylene group; or

III) a brominated 1,2,3-triazole.

4. A nonaqueous electrolyte solution as in any of Claims 1-3 wherein the diazole ring is a pyrazole ring.

5. A nonaqueous electrolyte solution as in any of Claims 1-2 wherein

the brominated triazole is 4-bromo-1-methyl-1,2,3-triazole, 4-bromo-1-(2-methoxyethyl)-1,2,3-triazole, 4,5-dibromo-1-methyl-1,2,3-triazole, or 4,5-dibromo-1-[(2-methoxyethoxy)ethyl]-1,2,3-triazole, 4,5-dibromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}-1,2,3-triazole, 3-bromo-4-methyl-1,2,4-triazole, 3-bromo-4-(2-methoxyethyl)-1,2,4-triazole, 3,5-dibromo-4-methyl-1,2,4-triazole, 3,5-dibromo-4-(2-methoxyethyl)-1,2,4-triazole, 3-bromo-4-methyl-1,2,4-triazole, 3-bromo-4-(2-methoxyethyl)-1,2,4-triazole, 3,5-dibromo-4-methyl-1,2,4-triazole, or 3,5-dibromo-4-(2-methoxyethyl)-1,2,4-triazole;

the brominated diazole is 4-bromo-1-methylpyrazole, 4-bromo-1-(2-methoxyethyl)pyrazole, 4-bromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4-dibromo-1-methylpyrazole, 3,4-dibromo-1-(2-methoxyethyl)pyrazole, 3,4-dibromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4,5-tribromo-1-methylpyrazole, 3,4,5-tribromo-1-(2-methoxyethyl)pyrazole, 3,4,5-tribromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4,5-tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}pyrazole, 4,5-dibromo-1-(2-methoxyethyl)-imidazole, 4,5-dibromo-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}imidazole, 2,4,5-tribromo-1-(2-methoxyethyl)-imidazole, or 2,4,5-tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}imidazole.

6. A nonaqueous electrolyte solution as in Claim 3 wherein

in II) the brominated triazole is 4,5-dibromo-1-[(2-methoxyethoxy)ethyl]-1,2,3-triazole or 4,5-dibromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}-1,2,3-triazole;

in I) the brominated diazole has a hydrocarbyl group bound to the N-H nitrogen atom of the diazole ring, the hydrocarbyl group having one to about four carbon atoms.

7. A nonaqueous electrolyte solution as in Claim 6 wherein the brominated diazole is 4-bromo-1-methylpyrazole.

8. A nonaqueous electrolyte solution as in any of Claims 1-3, 4, 5, or 6 wherein the brominated flame retardant is

a brominated pyrazole having one bromine atom bound to a carbon atom of the pyrazole ring, and the brominated pyrazole is in an amount of about 12 wt% or more bromine relative to the total weight of the solution; or

a brominated pyrazole having three bromine atoms, each bound to a carbon atom of the pyrazole ring, and the brominated pyrazole is in an amount of about 17 wt% or more bromine relative to the total weight of the solution.

9. A nonaqueous electrolyte solution as in any of Claims 1-3, 4-5, 6, or 7-8 wherein the liquid electrolyte medium is ethylene carbonate, ethyl methyl carbonate, or a mixture thereof, and/or wherein the lithium-containing salt is lithium hexafluorophosphate, lithium di(fluoro)(oxalato)borate, or lithium bis(oxalato)borate.

10. A nonaqueous electrolyte solution as in any of Claims 1-3, 4-5, 6, 7-8, or 9 further comprising at least one electrochemical additive selected from:

I)

a) unsaturated cyclic carbonates containing three to about six carbon atoms,
b) fluorine-containing saturated cyclic carbonates containing three to about five carbon atoms and one to about four fluorine atoms,
c) tris(trihydrocarbylsilyl) phosphites containing three to about nine carbon atoms,
d) trihydrocarbyl phosphates containing three to about twelve carbon atoms,
e) cyclic sultones containing three to about eight carbon atoms,

f) saturated cyclic hydrocarbyl sulfites having a 5-membered or 6-membered ring and containing two to about six carbon atoms,
g) saturated cyclic hydrocarbyl sulfates having a 5-membered or 6-membered ring and containing two to about six carbon atoms,
h) cyclic dioxadithio polyoxide compounds having a 6-membered, 7-membered, or 8-membered ring and containing two to about six carbon atoms,
i) another lithium-containing salt, and
j) mixtures of any two or more of the foregoing; or

II)

a) unsaturated cyclic carbonates containing three to about four carbon atoms,
b) fluorine-containing saturated cyclic carbonates containing three to about four carbon atoms and one to about two fluorine atoms,
c) tris(trihydrocarbylsilyl) phosphites containing three to about six carbon atoms,
d) trihydrocarbyl phosphates containing three to about nine carbon atoms,
e) cyclic sultones containing three to about four carbon atoms,
f) saturated cyclic hydrocarbyl sulfites having a 5-membered ring and containing two to about four carbon atoms,
g) saturated cyclic hydrocarbyl sulfates having a 5-membered ring and containing two to about four carbon atoms,
h) cyclic dioxadithio polyoxide compounds having a 6-membered or 7-membered ring and containing two to about four carbon atoms,
i) another lithium-containing salt, and
j) mixtures of any two or more of the foregoing.

11. A solution as in Claim 10 wherein the electrochemical additive is selected from:

a) an unsaturated cyclic carbonate in an amount of about 0.5 wt% to about 12 wt%, relative to the total weight of the nonaqueous electrolyte solution,
b) a fluorine-containing saturated cyclic carbonate in an amount of about 0.5 wt% to about 8 wt%, relative to the total weight of the nonaqueous electrolyte solution,
c) a tris(trihydrocarbylsilyl) phosphite in an amount of about 0.1 wt% to about 5 wt%, relative to the total weight of the nonaqueous electrolyte solution,

d) a trihydrocarbyl phosphate in an amount of about 0.5 wt% to about 5 wt%, relative to the total weight of the nonaqueous electrolyte solution,
e) a cyclic sultone in an amount of about 0.25 wt% to about 5 wt%, relative to the total weight of the nonaqueous electrolyte solution,
f) a saturated cyclic hydrocarbyl sulfite in an amount of about 0.5 wt% to about 5 wt%, relative to the total weight of the nonaqueous electrolyte solution,
g) a saturated cyclic hydrocarbyl sulfate in an amount of about 0.25 wt% to about 5 wt%, relative to the total weight of the nonaqueous electrolyte solution,
h) a cyclic dioxadithio polyoxide compound in an amount of about 0.5 wt% to about 5 wt%, relative to the total weight of the nonaqueous electrolyte solution,
i) another lithium-containing salt in an amount of about 0.5 wt% to about 5 wt%, relative to the total weight of the nonaqueous electrolyte solution, and
j) mixtures of any two or more of the foregoing.

12. A nonaqueous electrolyte solution as in any of Claims 10 or 11 wherein each electrochemical additive is not used with other electrochemical additives.

13. A nonaqueous electrolyte solution as in any of Claims 1-3, 4-5, 6, 7-8, 9-10, or 11 wherein the solution further comprises a nitrile compound, optionally wherein the nitrile compound is succinonitrile, or wherein the solution further comprises a nitrile compound and another lithium-containing salt, optionally wherein the nitrile compound is succinonitrile and the lithium-containing salt is lithium di(fluoro)(oxalato)borate.

14. A nonaqueous electrolyte solution for a lithium battery as in Claim 1, in which the at least one brominated flame retardant is selected from the group consisting of 4-bromo-1-methylpyrazole (4-bromo-1-methyl-1,2-diazole), 4-bromo-1-(2-methoxyethyl)pyrazole, 4-bromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4-dibromo-1-methylpyrazole, 3,4-dibromo-1-(2-methoxyethyl)pyrazole, 3,4-dibromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4,5-tribromo-1-methylpyrazole, 3,4,5-tribromo-1-(2-methoxyethyl)pyrazole, 3,4,5-tribromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4,5-tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}pyrazole, 4,5-dibromo-1-(2-methoxyethyl)-imidazole, 4,5-dibromo-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}imidazole, 2,4,5-tribromo-1-(2-

methoxyethyl)-imidazole, 2,4,5-tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}imidazole, 4-bromo-1-methyl-1,2,3-triazole, 4-bromo-1-(2-methoxyethyl)-1,2,3-triazole, 4,5-dibromo-1-methyl-1,2,3-triazole, 4,5-dibromo-1-[(2-methoxyethoxy)ethyl]-1,2,3-triazole, 4,5-dibromo-1-{2-[2-(2-methoxyethoxy)ethoxy]}ethyl}-1,2,3-triazole, 3-bromo-4-methyl-1,2,4-triazole, 3-bromo-4-(2-methoxyethyl)-1,2,4-triazole, 3,5-dibromo-4-methyl-1,2,4-triazole, and 3,5-dibromo-4-(2-methoxyethyl)-1,2,4-triazole.

15. A nonaqueous electrolyte solution as in Claim 14 wherein the brominated flame retardant is 4-bromo-1-methylpyrazole.

16. A nonaqueous electrolyte solution as in Claim 14 wherein the brominated flame retardant is

a brominated pyrazole having one bromine atom bound to a carbon atom of the pyrazole ring, and the brominated pyrazole is in an amount of about 12 wt% or more bromine relative to the total weight of the solution;

a brominated pyrazole having three bromine atoms, each bound to a carbon atom of the pyrazole ring, and the brominated pyrazole is in an amount of about 17 wt% or more bromine relative to the total weight of the solution.

17. A nonaqueous electrolyte solution as in any of Claims 14-15 wherein the liquid electrolyte medium is ethylene carbonate, ethyl methyl carbonate, or a mixture thereof, and/or wherein the lithium-containing salt is lithium hexafluorophosphate, lithium di(fluoro)(oxalato)borate, or lithium bis(oxalato)borate.

18. A nonaqueous electrolyte solution as in any of Claims 14-16 or 17 wherein the solution further comprises a nitrile compound, optionally wherein the nitrile compound is succinonitrile; or a nitrile compound and another lithium-containing salt, optionally wherein the nitrile compound is succinonitrile and the lithium-containing salt is lithium di(fluoro)(oxalato)borate.

19. A nonaqueous lithium battery comprising a positive electrode, a negative electrode, and a nonaqueous electrolyte solution as in any of Claims 1-3, 4-5, 6, 7-8, 9-10, 11-13, 14-16, or 17-18.

20. A process for producing a nonaqueous electrolyte solution for a lithium battery, which process comprises combining components comprising:

i) a liquid electrolyte medium;

ii) a lithium-containing salt; and

iii) at least one brominated flame retardant selected from

a) a brominated diazole having at least one bromine atom bound to a carbon atom of the diazole ring and a substituent on the N-H nitrogen atom of the diazole ring, and when the diazole is an imidazole, there are at least two bromine atoms bound to the diazole ring, or

b) a brominated triazole having one or two bromine atoms bound to carbon atoms of the triazole ring and a substituent on the N-H nitrogen atom of the triazole ring, the substituent being a hydrocarbyl group or an ether group, and when the triazole is a 1,2,4-triazole, there are either two bromine atoms bound to the carbon atoms of the triazole ring, or one bromine atom and one hydrogen atom bound to the carbon atoms of the triazole ring.

21. A process as in Claim 20 wherein the components further comprise at least one electrochemical additive selected from:

a) unsaturated cyclic carbonates containing three to about six carbon atoms,

b) fluorine-containing saturated cyclic carbonates containing three to about five carbon atoms and one to about four fluorine atoms,

c) tris(trihydrocarbylsilyl) phosphites containing three to about nine carbon atoms,

d) trihydrocarbyl phosphates containing three to about twelve carbon atoms,

e) cyclic sultones containing three to about eight carbon atoms,

f) saturated cyclic hydrocarbyl sulfites having a 5-membered or 6-membered ring and containing two to about six carbon atoms,

g) saturated cyclic hydrocarbyl sulfates having a 5-membered or 6-membered ring and containing two to about six carbon atoms,

h) cyclic dioxadithio polyoxide compounds having a 6-membered, 7-membered, or 8-membered ring and containing two to about six carbon atoms,

i) another lithium-containing salt, and

j) mixtures of any two or more of the foregoing; and/or

wherein the components further comprise a nitrile compound, optionally wherein the nitrile compound is succinonitrile; or a nitrile compound and another lithium-containing salt, optionally wherein the nitrile compound is succinonitrile and the lithium-containing salt is lithium di(fluoro)(oxalato)borate.

22. A process for producing a nonaqueous electrolyte solution for a lithium battery as in Claim 20, in which the

at least one brominated flame retardant is selected from the group consisting of 4-bromo-1-methylpyrazole (4-bromo-1-methyl-1,2-diazole), 4-bromo-1-(2-methoxyethyl)pyrazole, 4-bromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4-dibromo-1-methylpyrazole, 3,4-dibromo-1-(2-methoxyethyl)pyrazole, 3,4-dibromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4,5-tribromo-1-methylpyrazole, 3,4,5-tribromo-1-(2-methoxyethyl)pyrazole, 3,4,5-tribromo-1-[2-(2-methoxyethoxy)ethyl]pyrazole, 3,4,5-tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}pyrazole, 4,5-dibromo-1-(2-methoxyethyl)-imidazole, 4,5-dibromo-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}imidazole, 2,4,5-tribromo-1-(2-methoxyethyl)-imidazole, 2,4,5-tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}imidazole, 4-bromo-1-methyl-1,2,3-triazole, 4-bromo-1-(2-methoxyethyl)-1,2,3-triazole, 4,5-dibromo-1-methyl-1,2,3-triazole, 4,5-dibromo-1-[(2-methoxyethoxy)ethyl]-1,2,3-triazole, 4,5-dibromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}-1,2,3-triazole, 3-bromo-4-methyl-1,2,4-triazole, 3-bromo-4-(2-methoxyethyl)-1,2,4-triazole, 3,5-dibromo-4-methyl-1,2,4-triazole, and 3,5-dibromo-4-(2-methoxyethyl)-1,2,4-triazole.

23. A process as in Claim 22 wherein the components further comprise:

at least one electrochemical additive selected from vinylene carbonate, 4-fluoro-ethylene carbonate, tris(trimethylsilyl)phosphite, triallyl phosphate, 1,3-propane sultone, 1,3-propene sultone, ethylene sulfite, 1,3,2-dioxathiolane 2,2-dioxide, 1,5,2,4-dioxadithiane 2,2,4,4-tetroxide, lithium di(fluoro)(oxalato)borate, lithium bis(oxalato)borate, and mixtures of any two or more of these; and/or

a nitrile compound, optionally wherein the nitrile compound is succinonitrile, or wherein the components further comprise a nitrile compound and another lithium-containing salt, optionally wherein the nitrile compound is succinonitrile and the lithium-containing salt is lithium di(fluoro)(oxalato)borate.

24. Each of the following molecules separately, as a new composition of matter:

3,4,5-Tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}pyrazole;

4,5-Dibromo-1-(2-methoxyethyl)-imidazole;

2,4,5-Tribromo-1-{2-[2-(2-methoxyethoxy)ethoxy]ethyl}imidazole;

4,5-Dibromo-1-[(2-methoxyethoxy)ethyl]-1,2,3-triazole.