Claims:

1. A lithium ion cell comprising:

a negative electrode comprising from about 75 wt% to about 92 wt% an active material, from about 1 wt% to about 7 wt% nanoscale conductive carbon and from about 6 wt % to about 20 wt% polymer binder, wherein the active material comprises from about 35 wt% to about 95 wt% silicon oxide-based material and from about 5 wt% to about 65 wt% graphite;

a positive electrode comprising a lithium nickel cobalt manganese oxide approximately represented by the formula $LiNi_xMn_yCo_zO_2$, where $x + y + z \approx 1$, $0.3 \leq x$, $0.025 \leq y \leq 0.35$, $0.025 \leq z \leq 0.35$, conductive carbon, and a polymer binder;

a separator between the negative electrode and the positive electrode;

electrolyte comprising from about 1M to about 2 M lithium salt and non-aqueous solvent, wherein the non-aqueous solvent comprises from about 5 volume percent to about 20 volume percent fluoroethylene carbonate, at least about 25 volume percent combined amount of dimethylcarbonate and methylethylcarbonate, and from about 20 volume percent to about 50 volume percent diethylcarbonate, and wherein the electrolyte is substantially free of ethylene carbonate; and

a container enclosing the other cell components.

2. The lithium ion cell of claim 1, wherein the lithium ion cell can be cycled at a charge rate of 1C and a discharge rate of 1C for at least about 700 cycles without a drop in capacity of more than 20% relative to the 3rd cycle capacity.

3. The lithium ion cell of claim 1 or claim 2, wherein the negative electrode active material comprises from about 40 wt% to about 90 wt% silicon-oxide based material and from about 10 wt% to about 60 wt% graphite, wherein the graphite has a BET surface area from about 2 m^2/g to about 100 m^2/g.

4. The lithium ion cell of claim 3, wherein the silicon oxide-based material comprises a silicon-silicon oxide carbon composite material.

5. The lithium ion cell of any one of claims 1-4, wherein the polymer binder of the negative electrode comprises a blend of polyimide and a second binder polymer selected from the group consisting of poly vinylidene fluoride, carboxymethyl cellulose, styrene-butadiene rubber, lithiated polyacrylic acid, copolymers thereof and mixtures thereof.

6. The lithium ion cell of any one of claims 1-5, wherein the electrolyte comprises from about 1.25 M to about 1.8 M lithium salt and wherein the non-aqueous solvent comprises from about 8 volume percent to about 15 volume percent fluoroethylene carbonate and at least about 50 volume percent combined amount of dimethylcarbonate, methylethylcarbonate, and diethyl carbonate.

7. The lithium ion cell of any one of claims 1-5, wherein the electrolyte further comprises from about 2 wt% to about 12 wt% of propylene carbonate and from about 2 wt% to about 12 wt% of fluorobenzene.

8. The lithium ion cell of any one of claims 1-7, wherein the lithium nickel manganese cobalt oxide is approximately represented by the formula $LiNi_xMn_yCo_zO_2$, where $x + y + z \approx 1$, $0.50 \leq x$, $0.03 \leq y \leq 0.325$, $0.03 \leq z \leq 0.325$.

9. The lithium ion cell of any one of claims 1-8, further comprising supplemental lithium in an amount from about 80% to about 180% of the negative electrode first cycle irreversible capacity loss, the lithium ion cell having a ratio at the fourth cycle at a discharge rate of C/3 of negative electrode capacity divided by the positive electrode capacity from about 1.10 to about 1.95.

10. The lithium ion cell of any one of claims 1-9, wherein the positive electrode further comprises from about 20 wt% to about 80 wt% of (lithium + manganese) rich lithium metal oxide represented by the formula $Li_{1+b}Ni_\alpha Mn_\beta Co_\gamma A_\delta O_{2-z}F_z$, where $b + \alpha + \beta + \gamma + \delta \approx 1$, b ranges from about 0.04 to about 0.3, α ranges from 0 to about 0.4, β range from about 0.2 to about 0.65, γ ranges from 0 to about 0.46, δ ranges from about 0 to about 0.15 and z ranges from 0 to 0.2, with the proviso that both α and γ are not 0, and where A is a metal different from lithium, manganese, nickel and cobalt.

11. A lithium ion cell comprising:

a negative electrode comprising from about 75 wt% to about 92 wt% an active material, from about 1 wt% to about 7 wt% nanoscale conductive carbon and from about 6 wt % to about 20 wt% polymer binder, wherein the active material comprises from about 40 wt% to about 95 wt% silicon oxide-based material and from about 5 wt% to about 60 wt% graphite;

a positive electrode comprising a nickel-rich lithium nickel cobalt metal oxide, conductive carbon, and a polymer binder, where the nickel-rich lithium metal cobalt oxide is approximately represented by the formula $LiNi_xM_yCo_zO_2$, where $x + y + z \approx 1$, $0.3 \leq x$, $0.025 \leq y \leq 0.35$, $0.025 \leq z \leq 0.35$ and M is Mn, Al, Mg, Sr, Ba, Cd, Zn, Ga, B, Zr, Ti, Ca, Ce, Y, Nb, Cr, Fe, V, or combinations thereof;

a separator between the negative electrode and the positive electrode;

electrolyte comprising from about 1M to about 2 M lithium salt and non-aqueous solvent, wherein the non-aqueous solvent comprises from about 5 volume percent to about 20 volume percent fluoroethylene carbonate, at least about 25 volume percent combined amount of dimethylcarbonate and methylethylcarbonate, and from about 20 volume percent to about 50 volume percent diethylcarbonate, and wherein the electrolyte is substantially free of ethylene carbonate; and

a container enclosing the other cell components,

wherein the lithium ion cell can be cycled at a charge rate of 1C and a discharge rate of 1C for at least about 700 cycles without a drop in capacity of more than 20% relative to the 3rd cycle capacity.

12. The lithium ion cell of claim 11, wherein the lithium ion cell can be cycled at a charge rate of 1C and a discharge rate of 1C for at least about 750 cycles without a drop in capacity of more than 20% relative to the 3rd cycle capacity.

13. The lithium ion cell of claim 11 or claim 12, wherein the negative electrode active material comprises from about 50 wt% to about 90 wt% silicon-oxide based material and from about 10 wt% to about 50 wt% graphite, wherein the graphite has a BET surface area from about 2 m^2/g to about 100 m^2/g.

14. The lithium ion cell of claim 13, wherein the silicon oxide-based material comprises a silicon-silicon oxide carbon composite material.

15. The lithium ion cell of any one of claims 11-14, wherein the polymer binder of the negative electrode comprises a blend of polyimide and a second binder polymer selected from the group consisting of poly vinylidene fluoride, carboxymethyl cellulose, styrene-butadiene rubber, lithiated polyacrylic acid, copolymers thereof and mixtures thereof.

16. The lithium ion cell of any one of claims 11-15, wherein the electrolyte comprises from about 1.25 M to about 1.8 M lithium salt and wherein the non-aqueous solvent comprises from about 8 volume percent to about 15 volume percent fluoroethylene carbonate and at least about 50 volume percent combined amount of dimethylcarbonate, methylethylcarbonate, and diethyl carbonate.

17. The lithium ion cell of any one of claims 11-15, wherein the electrolyte further comprises from about 2 wt% to about 12 wt% of propylene carbonate and from about 2 wt% to about 12 wt% of fluorobenzene.

18. The lithium ion cell of any one of claims 11-17, wherein the lithium nickel metal cobalt oxide is approximately represented by the formula $LiNi_xMn_yCo_zO_2$, where $x + y + z \approx 1$, $0.50 \leq x$, $0.03 \leq y \leq 0.325$, $0.03 \leq z \leq 0.325$.

19. The lithium ion cell of any one of claims 11-18, further comprising supplemental lithium in an amount from about 80% to about 180% of the negative electrode first cycle irreversible capacity loss, the lithium ion cell having a ratio at the fourth cycle at a discharge rate of C/3 of negative electrode capacity divided by the positive electrode capacity from about 1.10 to about 1.95.

20. The lithium ion cell of any one of claims 11-19, wherein the lithium ion cell can be cycled at a charge rate of 1C and a discharge rate of 1C for at least about 800 cycles without a drop in capacity of more than 20% relative to the 3rd cycle capacity.