Claims

1. A silicon-carbon composite comprising:
    a. a carbon scaffold comprising a pore volume, wherein the pore volume comprises greater than 80% microporosity;
    b. a silicon content of 40% to 60% by weight;
    c. a Z of less than 5, wherein Z = 1.875 x [(M1100 – M)/M1100] x 100, wherein M1100 is a mass of the silicon-carbon composite at 1100 °C and M is the minimum mass of the silicon-carbon composite between 800 °C and 1100 °C when the silicon-carbon composite is heated under air from 25 °C to 1100 °C, as determined by thermogravimetric analysis;
    d. a surface area less than 30 m^2/g; and
    e. a φ of greater than or equal to 0.12, wherein φ = (Max peak height dQ/dV in Regime I) / (Max peak height dQ/dV in Regime III), wherein dQ/dV is measured in a half-cell coin cell, and Regime I is 0.8V-0.4V and Regime III is 0.15V-0V.

2. The silicon-carbon composite of claim 1, wherein the pore volume comprises greater than 90% microporosity.

3. The silicon-carbon composite of claim 1, wherein the pore volume comprises greater than 95% microporosity.

4. The silicon-carbon composite of any one of claim 1, comprising a surface area less than 10 m^2/g.

5. The silicon-carbon composite of claim 2, comprising a surface area less than 10 m^2/g.

6. The silicon-carbon composite of claim 1, wherein the Z is less than 4.

7. The silicon-carbon composite of claim 2, wherein the Z is less than 4.

8. The silicon carbon composite of claim 1, wherein the silicon-carbon composite comprises a Dv50 ranging from 5 nm to 20 microns.

9. The silicon carbon composite of claim 2, wherein the silicon-carbon composite comprises a Dv50 ranging from 5 nm to 20 microns.

10. The silicon carbon composite of claim 1, wherein the silicon-carbon composite comprises a capacity of greater than 900 mA/g.

11. The silicon carbon composite of claim 2, wherein the silicon-carbon composite comprises a capacity of greater than 900 mA/g.

12. The silicon-carbon composite of claim 1, further comprising lithium ions.

13. The silicon-carbon composite of claim 2, further comprising lithium ions.

14. The silicon-carbon composite of any one of claims 1-13, wherein $\varphi \geq 0.13$.

15. The silicon-carbon composite of any one of claims 1-13, wherein $\varphi \geq 0.14$.

16. The silicon-carbon composite of any one of claims 1-13, wherein $\varphi \geq 0.15$.