an electrode in a Li-ion battery. The sample tested resulted in an initial charge capacity of 1800 mAh/g and a discharge capacity of 1300 mAh/g. The battery was prepared as follows. The Si-based nanowires (80% weight) were mixed with 10 wt. % of super P carbon and 10 wt. % PVDF binder. N-Methyl-2-pyrrolidone (NMP) was used as the solvent to dissolve NMP. The slurry was then cast on a Cu foil. The thickness of the cathode is ~0.2 mm thick. Electrochemical performance of the Si based anode was tested in a coin cell (type 2325) configuration. Li metal and a porous membrane was used as the counter electrode and separator, respectively. 1M $LiPF_6$ in EC:DEC (1:1) was used as an electrolyte. The coin cell was assembled in an argon filled glove box. Batteries were tested in a Battery Testing System to produce the plot in FIG. **4**.

Attempts to synthesize nanowires without introduction of a vapor source were unsuccessful. Quartz furnaces were utilized to avoid residual carbon associated with graphite furnaces. An oxygen trap was used to minimize oxygen contamination. Catalyst precursors were selected to minimize contamination from the ligands. For example, $Ni(N_{O3})_2$ was used as opposed to $Ni(C_{H3}COO)_2$, which tends to leave carbon contamination. Under such conditions, little or no nanowire growth occurred because, as described earlier, the present invention requires the presence of both a vapor source and a solid source.

The prevailing mechanism for nanowire growth according to embodiments of the present invention appears to be the reaction between elements in the vapor source and the semiconductor constituent in the liquid, mixed phase comprising the semiconductor and the catalyst. The consumption of the semiconductor element from the liquid mixed phase establishes a gradient that draws additional semiconductor material from the solid source. Accordingly, the semiconductor powder granules are consumed during nanowire synthesis.

While the examples described herein involve Si as the semiconductor solid source, the present invention is not limited to such. Other suitable materials can include, but are not limited to, Ge and Sn. Using vapor sources that contain oxygen, carbon, or nitrogen, nanowires comprising Ge, Ge_3N_4, GeO, GeO_2, Sn, SnO, SnO_2, etc., can be produced. Suitable catalysts for these growths can include, but are not limited to Ni, Fe, Al, Au, Cu, etc. The temperature for these growths will vary depending on the material system, but should generally occur at, or above, the approximate eutectic or peritectic point.

While a number of embodiments of the present invention have been shown and described, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from the invention in its broader aspects. The appended claims, therefore, are intended to cover all such changes and modifications as they fall within the true spirit and scope of the invention.

We claim:

1. A method of fabricating nanowires comprising first and second elements, the method characterized by:

coating solid powder granules comprising the first element with a catalyst, wherein the catalyst and the first element form a liquid, mixed phase having a eutectic or pertectic point when heated;

heating the granules coated with the catalyst to a temperature greater than, or equal to, the eutectic or peritectic point; and

introducing during said heating a vapor source comprising the second element, wherein the vapor source chemically interacts with the liquid, mixed phase to consume the first element and to induce condensation of a product comprising the first and second elements that forms the nanowires.

2. The method of claim **1**, wherein the product has a higher melting point than the first element.

3. The method of claim **1**, wherein the first element comprises Si.

4. The method of claim **3**, further comprising forming the nanowires into an electrode in an energy storage device having a discharge capacity greater than or equal to 400 mAh/g.

5. The method of claim **4**, wherein the energy storage device is a Li-ion battery.

6. The method of claim **3**, wherein the second element comprises Si.

7. The method of claim **6**, wherein the vapor source comprises $SiCl_4$.

8. The method of claim **3**, wherein the catalyst comprises Ni and the temperature is between 900° C. and 1050° C.

9. The method of claim **1**, wherein the first element comprises Ge or Sn.

10. The method of claim **1**, wherein the second element comprises oxygen, nitrogen, carbon, or combinations thereof.

11. The method of claim **1**, wherein the catalyst comprises Ni, Fe, Al, Au, Cu, or combinations thereof.

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