Creation of Nanowires for Energy Saving Applications

University of Wisconsin-Eau Claire
Caramon Ives, Jason Leicht, Bret Meier
Dr. Doug Dunham and Dr. Marc McEllistrem

The Issue

With nearly everything we use in modern society being electronic, energy consumption is a high cost factor. Most electronics draw small amounts of power when plugged in. This is because transistors have on and off states corresponding to smaller electric currents. This smaller current still exists when the device is "off". Finding some way to reduce this drain would save money and reduce wasted energy.

Possible Solution

Mechanical (light) switches completely sever the flow of charge to the object. Nanoswitches work in the same manner on a smaller scale. SiC (silicon carbide) is a semiconductor that has been proven to be a viable option for the construction of nanoswitches because of its unique electrical properties.

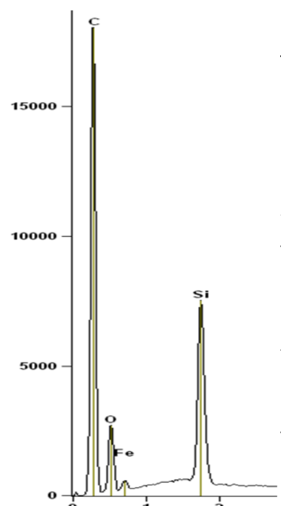
Challenges

The formation of SiC nanowires is particularly difficult because of the unique environment needed to stimulate their growth. High temperatures and an oxygen depleted environment are crucial for their synthesis. Due to the scale of these objects, the characterization process presents many challenges.

Furnace Process

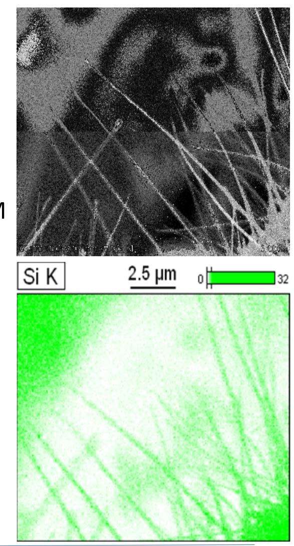
Samples were prepared from a FeSi mixture on a graphite planchet. A wide range of weight ratios were used. The planchet rested in an alumina crucible that was able to reach temperatures of over 1600ºC.

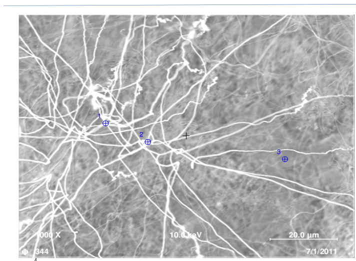
The crucible was placed into a furnace that was able to reach 1600ºC. Normally the temperature was held constant at 1600ºC for 6-12 hrs. During the heating process a steady flow of argon through the furnace ensured an oxygen depleted environment needed for our synthesis.

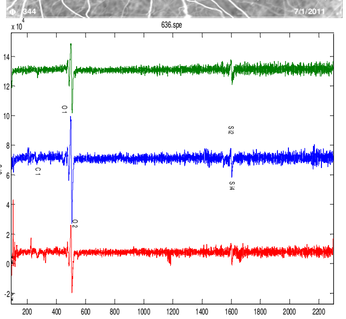


Analysis

There were two primary methods of analysis: the SEM (Scanning Electron Microscope) and the Auger electron microscope. The SEM was used for quick analysis of the samples to get an overview of the composition and topography; whereas the Auger was used to obtain a higher resolution analysis of areas of interest identified by the SEM. Elemental categorization on right.



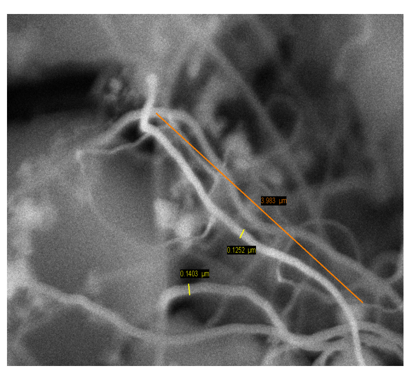




Further Examination

The image to the left is an illustration of a series of scans on one of the samples of nanowires.

The right image is the elemental analysis of the corresponding points on the graph at left. There are identifiable Carbon and Silicon peaks in the sample. Oxygen is known to be measured in all samples on Auger, hence the strong peak.



The above picture was taken on an SEM at 20,000x magnification

Conclusion

Today's switches are manufactured primarily of Silicon. The above images are scans done of wires we have created in lab. Fabricated Silicon Carbide wires would drastically lengthen longevity as well as remain efficient at high temperatures.

The images to the left are an example of Silicon Carbide nanowires which we have already grown. For further application we would need only to control the growth location of the wires and continue to improve our consistency of synthesis.

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