Announcing the Final Examination of Robert Mertens for the degree of Doctor of Philosophy

Time & Location: June 27, 2012 at 11:00 AM in HEC 450
Title: CHARACTERIZATION, MORPHOLOGY, OXIDATION AND RECESSION OF SILICON NANOWIRES GROWN BY ELECTROLESS PROCESS

Main: This dissertation presents heretofore undiscovered properties of SiNWs grown by electroless process and presents mathematical solutions to the special problems of the oxidation and diffusion of dopants for SiNWs. Also presented here is a mathematical description of morphology of oxidized SiNWs.

Chapter 2: Silicon nanowires (SiNWs) were grown by the electroless etching technique using silver nitrate (AgNO3)/hydrofluoric acid (HF) solution on a patterned p-type Silicon (Si) substrate with varying etching times and concentrations. The various etch times and concentrations produced different recession depths wherever the pattern allowed the etching solution to contact the Si substrate. At the bottom of each recession, SiNWs were produced of varying length and size, according to the depth of the recession. In this type of growth procedure, as SiNWs are grown, the tips are etched away. SiNWs grown by this method tend to agglomerate at their tips. We report that the recession and height of SiNWs grown by the electroless process can be controlled directly by the concentration of HF in the etching solution and by the etching time. Under precise conditions, the recession of SiNWs can be very nearly eliminated or nearly complete. The heights of SiNWs can also be fairly well controlled. We report that the growth of SiNWs is highly dependent on the ratio of volume of etching solution to the exposed surface area.

Chapter 3: Silicon nanowires were created via the electroless etching technique using silver nitrate (AgNO3)/hydrofluoric acid (HF) solution. The prepared raw samples were oxidized for various intervals, so as to have an end result of various nanowire thicknesses. Scanning electron microscope (SEM) images were taken of the original nanowires, the oxidized nanowires and then the oxidized and etched (in HF solution) nanowires. When Silicon nanowires are made, the area of exposed Silicon undergoes "amplification," a formula for which is provided herein. When Silicon nanowires are oxidized, the growth rate of the oxide layer varies according to the crystalline alignment. A formula for a polar plot is provided for illustrating the shape of a Silicon nanowire after oxidation for various intervals, based on the Deal-Grove and Massoud models of oxidation.

Major: Electrical Engineering

Educational Career:
Bachelor's of Physics, BS, 1990, University of Central Florida
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Committee in Charge:
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Dr. Louis C. Chow, MMAE
Dr. Richard G. Blair, Chemistry

Approved for distribution by Dr. Kalpathy B. Sundaram, Committee Chair, on June 8, 2012.

The public is welcome to attend.