SUBJECT: Ph.D. Proposal Presentation

BY: Surajit Kumar

TIME: Tuesday, 17 January 2006 at 10 am

LOCATION: Love Building, Room 311

TITLE: Application of Microfluidics and Electric Fields for Sorting of Metal Oxide Semiconductor Nanobelts and Nanodevice Fabrication

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SUMMARY

Nanobelts are a new class of semiconducting metal oxide nanowires. The ribbon-like nanobelts are chemically pure and structurally uniform single crystals, with clean, sharp, smooth surfaces, and rectangular cross sections. Nanobelts have great potential as building blocks for nanoscale electronic devices. To realize this potential, manipulation methods are required. In addition, it is also important to separate and sort the nanobelts by size/length if one wishes to fabricate nanodevices with predefined electrode configurations. The present research focuses on nanobelt manipulation and sorting issues by combining solution phase processing methods with microfluidics and electric fields.

Fluid flow alignment process was used in the fabrication of a nanodevice based on SnO_2 nanobelts, which may be used as a gas sensor. Dielectrophoresis was demonstrated for the first time on semiconducting metal oxide nanobelts, which also resulted in the fabrication of a nanodevice. Dielectrophoresis studies were also performed on SnO_2 microparticles. Studies with DC electric fields in parallel plate electrode configuration have indicated the presence of electrophoresis in SnO_2 nanobelts and accompanying particles. To study traveling wave dielectrophoresis effects, four phase linear electrode arrays have been fabricated. For the experiments, nanobelt suspensions were produced using ethanol, kerosene and water.

Following the above results, this study proposes schemes for separation and sorting of nanobelts according to size/length from a suspension obtained using sonication of the raw nanobelt sample, which in turn is produced using a high temperature thermal evaporation method. Application of microfluidics and/or electric fields will allow different sorting schemes. A form of field flow fractionation (FFF) will be implemented, and the performance examined. For effective visualization of the nanobelt movement, it is proposed that quantum dots or fluorescent molecules will be conjugated to the nanobelts for fluorescence detection and imaging.