Information Technology and Materials Science

An opportunity exists in the merger of nanophase materials with microstructured devices. This developing area of materials science will impact information technology by providing new sensors, actuators, and motors that will allow one to discover and manipulate the world at the nanoscale. By manipulating and building the world atom by atom, this area of science is one of the most exciting crosscutting the disciplines of Chemistry, Physics, Biology, Engineering, and Medicine.

On the practical side, it has tremendous commercial potential in permitting fundamentally new devices as well as significantly enhancing current devices by making them smaller, faster, and more efficient. On the fundamental side, the world behaves differently when objects are made that are only atoms across. Quantum mechanics now plays a role and provides new opportunity to tailor material performance. Perhaps the most important example is the new quantum sensor employed in computer hard drives – its greatly enhanced sensitivity is the reason that we can buy multi-gigabyte hard drives.

Furthermore, somewhat like astronomy, the area has instant appeal to both students and to the public. They can see the devices, visualize the atomic structures, and first-hand, personally experience the benefits of the new capabilities that they provide.

What are the activities in this area?
- **Synthesis** of materials on the nanoscale: spheres, wires, rods, tubes, films
- **Characterization** of the properties of the nanomaterials
- **Assembly** of arrays of nanomaterials through templates, self-assembly, fluidics, etc.
- **Integration** into devices with totally new function from the nanoassemblies

What are the applications of these materials and devices?
- **electronics**
- **photonics** – optical computing and communications
- **magnetics** – data storage, sensing
- **chemical** & **biological** sensing
- **mechanical** manipulation, molecular motors

(See the accompanying powerpoint presentation for further elaboration: http://www.phys.lsu.edu/faculty/tohline/capital/nanomaterials.ppt)

The diversity of materials that are of general interest is vast. A recent Sackler Conference at the National Academy of Science focused on Nanotechnology highlighting the opportunities. The most exciting developments in nano were in the combination of nanophase materials with microstructured devices. These hybrid structures take advantage of the new quantum-mechanically controlled material properties and couple them to the world through a microdevice.

LSU is poised to contribute in this area – most of the necessary characterization tools are

present and CAMD is an exceptional resource for many advanced characterization needs. Many clever techniques have been devised for device fabrication and the details of the specific area of research will have to depend on the interests of the best candidates. The attached "presentation" provides a flavor of various activities that are ongoing in nanophase applied to synthesis and device applications. Many of these studies are "proof of concept" for synthesis routes and device construction and their commercial potential is significant and obvious. Note that one activity in that presentation is ongoing at LSU.

Recommendation:

A core cluster of faculty focused on nanophase synthesis that combines nanomaterials with microdevices. The most exciting areas of the future will be in bio and medical applications. The team should include investigators from the spectrum of disciplines mentioned above.