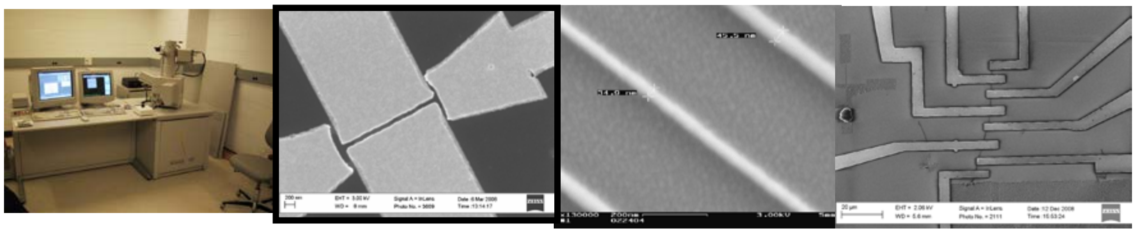
Nanoelectronics Group



Our work has led to the development of technology and applications for advanced nanoelectronic devices and nanofabrication methods. Currently, we are focusing on research post-CMOS oxide based devices and phonon transport at interfaces on the nano level.

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“Advancing research aimed at developing next-generation electronics.”

UNIVERSITY of VIRGINIA ENGINEERING

Nanoelectronics

In recent years, many advances have been made in the development of molecular scale devices. Experimental data shows that these devices have potential for use in both memory and logic. The field of molecular nanoelectronics is often defined as including any technology whose device feature sizes are on the scale of single molecules. One intriguing technology family within this field consists of devices based on self-assembled monolayers (SAM) of molecules sandwiched between two conducting terminals. Our work lies broadly within the fabrication of such devices with useful properties such as rectification, hysteresis, negative differential resistance, as well as novel electronic circuits.

Nanofabrication

Devices and circuits based on molecular electronics are now on the International Technology Roadmap for Semiconductors for scaling below ~30nm, where performance gains are expected to be severely limited. A major challenge in fabricating the circuit is the fidelity of the contacts upon interconnection of molecular devices, since the deposition and patterning of a top contact layer between adjoining devices impedes the chemical stability and electronic coupling at metal-molecule junctions, resulting in artifacts in the I-V characteristics. We are studying the fabrication of interconnected molecular devices using a variety of different methods.

Electron Beam Lithography

We are studying the effect of low energy (30 keV) electron beam exposure on carbon nanotube field-effect transistors, using an electron beam lithography system to provide spatially controlled dosage. We have demonstrated that reversible tuning of the transport behavior is possible when a backgate potential is applied during exposure. N-type behavior can be obtained by electron beam exposure of a device with positive gate bias, which ambipolar behavior can be obtained via negative gate bias. The observed transport behavior is relatively stable in time. We are working to understand the effects of e-beam exposure on a nanotube-based field-effect transistor which could lead to applications beyond field-effect transistors, for example, e-beam dosimeters and charge-coupled devices.

Photovoltaics

The sun provides a free and natural resource that has the potential to power all the world's energy needs. Yet today, the conversion of sun light to electron flow is highly inefficient and expensive. We are investigating the interaction of sunlight and matter at the nanoscale level to better understand charge generation, transfer and transport. With this knowledge in hand, researchers can then develop nanocrystalline materials that, when combined matrix and thin film materials, have the potential to create photovoltaic cells that are more efficient across a wider bandwidth and easier to manufacture.

RECENT RESEARCH DEVELOPMENTS

- Electrical switching in molecular nano-pore devices.
- Enhanced thermal transport through self-assembled molecular layers.

RECENT GRANTS

- Nanoelectronics Research Initiative – ViNC (Virginia Nanoelectronics Center

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