Georgia Institute of Technology

School of Materials Science and Engineering

MSE Seminar Monday, October 22, 2007

"Order, Structure and Devices in Nanoscale and Molecular Electronic Materials Science"

Presented by

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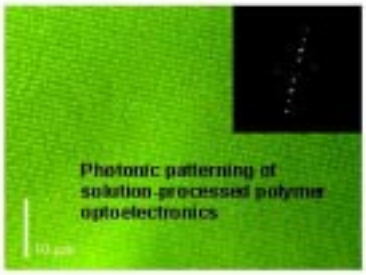
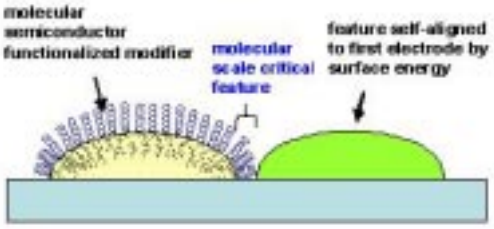
Monday, October 22, 2007
MaRC Auditorium
3:00 p.m.

ABSTRACT

The semiconductor industry continues its drive to high performance, lower cost and greater integration through relentless evolution. The core of the technology roadmap is based on feature size reduction through lithography scaling, dielectric thickness reduction and device integration with feature sizes at the size scale of molecules. At the same time, new tailored molecular and nanoscale electronic materials have emerged with an immense range of electronic, optical and chemical activity. Due to their molecular nature and nanoscale dimensions, these materials can also possess unique processibility and physical driving forces, such as surface energy effects and non-covalent bonding. This presents an immense opportunity for 'off roadmap' technologies based on structured and self-organized molecular materials — achieving molecular scale devices with optimized nanostructure by harnessing the inherent properties of these materials instead of relying on of extrinsic lithography efforts and complex process control. Of further interest are new devices and applications made possible by these new materials that are outside of, or complementary to, the capabilities of conventional Si. This includes new technologies in printed electronics, optoelectronics and sensors which are enabled by specific electronic, optical and chemical activity which can be built in to molecular organic and nanoscale semiconductors which can be fabricated using non-conventional means.





In this talk, some of the fundamental principles and motivations behind this new class of materials and processes will be introduced. Following this, will be a series of materials sets and process approach examples from the presenter's research which shows the interesting materials science of this new class of electronic materials and the exciting research, education and applications potential for these materials and device process approaches. This will include examples of structure property relations and 'text book' phase transformations in semiconducting polymer blend thin films. Moving on from this, some more advanced modifications of this concept with surface controlled phase separation and high performance molecular semiconductor materials will be discussed. Finally, research in printed nanoscale transistors which utilize surface energy modification to achieve molecular scale junctions will also bet presented. These examples will seek to show how these new materials allow investigation of fundamental materials science principles, elegantly structured semiconductor thin films and devices, and the potential for new applications in simple, inexpensive and scaleable process approaches.

BIO

Dr. MacKenzie is currently the Director of Technology at Add-Vision, developing printed flexible OLED technology and is responsible for all research, development and external technical projects including extensive collaborations with Merck OLED, Sumitomo Chemical, Lawrence Berkeley National Labs and a number of technology development partners. He is an internationally-recognized expert in the field of organic and printed electronics and has served as IP contributor and technical consultant to a number of leading companies in the field. These have included the International Roadmap for Semiconductors, Carbon Valley, Konarka, Kovio, and Cambridge Display Technology. Prior to entering industry, he was a research staff member in Professor Sir Richard Friend's group at the University of Cambridge investigating polymeric and molecular semiconductors, with particular focus on solution-derived nanostructures for the processing of OLEDs, photovoltaics, and photonics. At the University of Cambridge, he co-founded Plastic Logic, a leading company in printed polymer transistors. He has also worked extensively in Si-based nanotechnology with the MIT Media Lab spin-out, Kovio. Dr. MacKenzie is the author of over 120 technical publications and patents in nanoscale devices, RFID, printed TFT's, OLEDs, and photonics. Mr. MacKenzie earned his doctoral, masters and undergraduate degrees in Materials Science and Engineering at the University of Florida and the Massachusetts Institute of Technology.

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