BILKENT UNIVERSITY

unam - INSTITUTE of MATERIALS SCIENCE & NANOTECHNOLOGY

FACULTY OF SCIENCE

MATERIALS SCIENCE and NANOTECHNOLOGY GRADUATE PROGRAM SEMINAR

"Design, Synthesis and Characterization of Novel Organic Semiconductors for High Performance Organic Field-Effect Transistors: A Bright Future for Plastic Electronics"

Dr. Hakan Usta

Senior Research Scientist

Polyera Corporation, Illinois Science & Technology Park

Skokie, IL - USA

Organic π-conjugated semiconductors have been the focus of intense research over the past few decades as active materials for organic electronics such as organic light-emitting diodes (OLEDs), photovoltaic cells (OPVs), and field-effect transistors (OFETs). These materials enable vapor- or solution-phase fabrication of large-area, light-weight electronic devices, and are compatible with plastic substrates for mechanically flexible, conformable and wearable electronics. Although many research groups have developed and studied new organic small molecules and polymers as semiconductors with solution-based charge carrier mobilities ranging from 10^{-5} *to 0.1-0.4* $cm^2/V{\cdot}s$, only a few of the current materials meet the required chemical/physical and electronic properties to enable high-throughput printing techniques in ambient. Thus, the development of new solution-processable semiconductors exhibiting high field-effect carrier mobility and good stability under ambient conditions is of great interest. This study addresses these challenges via theory-aided rational design, synthesis and characterization of novel hole- and electron-transporting molecules and polymers. Solution-processed thin films of these semiconductors yield OFETs with high hole/electron mobilities of *0.1-0.3* $cm^2/V{\cdot}s$ and I_{on} /I_{off} ratios of 10^7–10^8, one of the highest device performance reported to date.[1-3]

We also report the first examples of polymeric and molecular ambipolar semiconductors in the literature to function in air. Furthermore, significant correlations are established between molecular/polymeric structures, physicochemical properties and OFET device performance, providing detailed insight into charge transport characteristics and ambient stability. These results, in total, affirm the possibility of achieving low-cost microelectronic devices through organic materials that enable simple solution fabrication processes under ambient conditions.

1. Usta, H. et al. Journal of the American Chemical Society, 2009, 131, 5586-5608.
2. Usta, H. et al. Journal of the American Chemical Society, 2008, 130, 8580-8581.
3. Usta, H. et al. Journal of the American Chemical Society, 2006, 128, 9034-9035.

Date : July 16, 2010 - Friday

Time : 15:40

Place : Faculty of Science Building, A Block, Seminar Room (SA 240)