

# A new structural view of organic electronic devices

September 12 2005

---

Although still in the qualifying rounds, U.S. researchers are helping manufacturers win the race to develop low-cost ways to commercialize a multitude of products based on inexpensive organic electronic materials -- from large solar-power arrays to electronic newspapers that can be bent and folded.

In the on-line issue of *Advanced Materials*,\* researchers from the National Institute of Standards and Technology (NIST) and the University of California at Berkeley report success in using a non-destructive measurement method to detail three structural properties crucial to making reliable electronic devices with thin films of the carbon-rich (organic) semiconductors. The new capability could help industry clear hurdles responsible for high manufacturing development costs that stand in the way of widespread commercial application of the materials.

With the technique called near-edge X-ray absorption fine-structure spectroscopy, or NEXAFS, the team tracked chemical reactions, molecular reordering and defect formation over a range of processing temperatures.

They then evaluated how process-induced changes in thin-film composition and structure affected the movement of charge carriers (either electrons or electron "holes") in organic field effect transistors, devices basic to electronic circuits. With NEXAFS measurements taken over the range from room temperature to 300 degrees Celsius, the team

monitored the conversion of a precursor chemical to an oligothiophene, an organic semiconductor. The molecular organization and composition achieved at 250 degrees Celsius yielded the highest levels of charge carrier movement and, consequently, maximum electric-current flow.

As chemical conversion progressed, the researchers calculated how the molecules arranged themselves on top of an electrical insulator. Top transistor performance corresponded to a vertical alignment of molecules. In addition, they used NEXAFS to determine the angles of chemical bonds and to assess the thickness and uniformity of film coverage, also critical to performance.

NEXAFS has the potential to be the "ideal measurement platform for systematic investigation" of organic electronic materials, says lead investigator Dean DeLongchamp, a NIST materials scientist. "A straightforward means of correlating chemical and physical structure to the electronic performance of organic semiconductor films is a much-needed tool."

\* D.M. DeLongchamp, S. Sambasivan, D.A. Fischer, E.K. Lin, P. Chang, A.R. Murphy, J.M.J. Frechet, and V. Subramanian, "Direct Correlation of Organic semiconductor film structure to field-effect mobility," *Advanced Materials*, published online Aug. 30, 2005, DOI number (10.1002/adma.200500253).

Source: NIST

Citation: A new structural view of organic electronic devices (2005, September 12) retrieved 10 April 2024 from <https://phys.org/news/2005-09-view-electronic-devices.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private

study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.