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GID Study of Conductive Polymers
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Beamline(s): X22B

Introduction: Recent work at the Naval Research Laboratory has indicated that the addition of hydrogen-bonding solvents to ethylenedioxythiophene oligomers such as Baytron P® (a commercial product) can result in films that are both transparent and highly conductive [1]. Furthermore, unexpected effects were seen in spin-cast films, with thinner films paradoxically displaying higher total conductivity than thicker films. Our goal in this experiment was to explore possible structural origins for the anomalous thickness dependence of the conductivity.

Methods and Materials: Hydrogenated and fluorinated polymers were spin-cast onto inert mica substrates at a variety of thicknesses and spin rates. Measurements were made using the surface spectrometer at X22 B, using a beam incident at less than the critical angle for typical organic materials. The outgoing beam was collimated using tall vertical Soller slits and a linear position-sensitive detector.

Results: Most samples showed multiple maxima near 1 $Å^{-1}$ corresponding to amorphous polymer order as previously observed in bulk samples [1]. A few samples also appeared to show crystalline diffraction arising from the polymer film at low angles. However, the mica substrates were unexpectedly curved, making GID measurements difficult and in some cases impossible, and we were not able to extract systematic differences between the different samples.

Conclusions: Further measurements on flat samples, with a different mounting scheme, will be required to achieve the original goals of this experiment.

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References:
[1] B. D. Martin, N. Nikolov, S. Pollack, R. Shashidhar, F. Zhang, and P. A. Heiney, “Development of Optically Transparent Conducting Polymers—A Hydrogen Bonding Approach,” submitted to Chem. Mater. (2002).