School Seminar (2016-15)

School of Materials Science & Engineering

"Highly Aligned Semiconducting Polymers for High-Mobility Polymer Field-Effect Transistors"

Dr. Lee, Byoung Hoon

(Center for Polymers and Organic Solids, Univ. of California, Santa Barbara)

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Byoung Hoon Lee

Center for Polymers and Organic Solids
University of California, Santa Barbara
Santa Barbara, California 93106, United States
Email: leebhoon@physics.ucsb.edu

As a result of the quasi-one-dimensional transport pathways of charge carriers along the backbone, charge transport in polymer semiconductors is limited by their nanomorphology. Structural disorders, arising from the high degree of conformational freedom of polymer chains (causing chain folding, torsion, and structural defects) lead to electronic localization. Thus, highly aligned polymer packing with minimized structural disorder is needed for achieving high mobility in semiconducting polymers. Our recent progress toward this goal using nanogrooved substrates has enabled us to obtain highly aligned semiconducting polymers. The aligned polymer thin films along nanogrooves in the substrate exhibited strong anisotropy and small effective mass, $m^* \approx 0.106 m_e$, implying the possibility of achieving high mobility along the polymer backbone. We have demonstrated polymer field-effect transistors with mobilities approaching 100 $cm^2/V\text{-}s$ using highly oriented and aligned semiconducting polymers as charge transport layers.