"BNC Seminar" REVISED TIME

Thursday, December 1, 2016 @ 1:45pm
BRK, ROOM 1001

Ying Diao
Assistant Professor & Dow Chemical Company Faculty Scholar
Department of Chemical and Biomolecular Engineering
University of Illinois at Urbana-Champaign, USA

Title: Directing Crystallization and Assembly for Printed Electronics

Abstract: Over the past thirty years, organic semiconductors have emerged as a new class of electronic and photoelectronic materials that are light-weight, flexible and can be manufactured using energy-efficient and high-throughput methods. The solution printability at near ambient conditions enables deposition on flexible polymer substrates to create wearable, stretchable, imperceptible electronic devices for use in applications unimagined before. On the other hand, key challenges remain: how does molecular assembly proceed during solution printing and how to control the resulting thin film morphology? The significance of this challenge lies in the fact that charge transport in printed thin films is highly sensitive to their morphological parameters from molecular, mesoscopic to device scale. Addressing this challenge can open up new avenues for attaining high electronic performances, facilitating the much needed structure-property relationship studies in electronic devices, and enabling new applications in energy harvesting and personalized healthcare. In this talk, we present several strategies we recently developed for controlling crystallization and assembly of organic semiconductors that are directly compatible with solution printing. With high degree of control over thin film alignment, molecular packing and mesostructures, we further correlate these morphological characteristics with charge transport properties towards establishing structure-property relationships. We also demonstrate potential applications of printed transistors in personalized healthcare and environmental monitoring.

Key References

[1] Diao, Mannsfeld, Bao et al.,"Solution Coating of Large-Area Organic Semiconductor Thin Films with Aligned Single-Crystalline Domains". *Nature Materials*. 2013, 12, 665-671. DOI:10.1038/nmat3650
[2] Diao*, Zhou*, Toney, Mannsfeld, Bao, et al.,"Flow-enhanced solution printing of allpolymer solar cells". *Nature Communications*. 2015. 6, 7955. DOI:10.1038/ncomms8955
[3] Diao, Aspuru-Guzik, Clancy, Bao, Mannsfeld, et al.,"Understanding Polymorphism in Organic Semiconductor Thin films Through Nanoconfinement". *JACS.* 2014, 136 (49), 17046- 17057. DOI: 10.1021/ja507179d
[4] Diao, Shaw, Bao, Mannsfeld, "Morphology Control Strategies for Solution-Processed Organic Field Effect Transistors". *Energy & Environmental Science*. 2014, 7, 2145-2159. DOI:10.1039/C4EE00688G
[5] Chung, H.; Diao, Y. "Polymorphism as an Emerging Design Strategy for High Performance Organic Electronics". *Journal of Materials Chemistry C*. (Invited paper for the 'Emerging Investigators' themed issue) 2016. Accepted. DOI: 10.1039/C5TC04390E
[6] Zhang, Diao et al., "Solution-Processed Nanoporous Organic Electronic Thin Films for Ultrasensitive Health and Environmental Monitoring". Under review.