TECHNISCHE UNIVERSITÄT CHEMNITZ

Institut für Physik
Physikalisches Kolloquium

Mittwoch, 11.01.2017, um **16:00 Uhr**

Ort: Reichenhainer Str. 90;
Zentrales Hörsaal- und Seminargebäude,
Raum 2/N013

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High Performance Morphologies in Solution-Sheared Films of Organic Semiconductors and Conductors

In both polycrystalline thin films of small organic semiconductor molecules and polymer thin films, the molecular packing determines the film's charge transport properties and consequently the electrical performance in thin-film devices such as organic thin film transistors (OTFTs) or solar cells. We have in the past few years demonstrated that the solution-shearing method produces remarkably well-performing film morphologies for small organic molecular materials, semiconducting polymers and most recently also conducting polymers.[1,2] Here we discuss results for solution-sheared films of the small organic semiconductor 6,13-bis(triisopropylsilylethynyl)pentacene (TIPS-pentacene) and the conducting polymer blend system PEDOT:PSS.[3]

With TIPS-pentacene thin films, we demonstrate that the so-called nanoconfinement effect combined with the solution-shearing based technique flow-enhanced crystal engineering (FLUENCE) is a powerful method to identify existing polymorphs in small organic semiconductor materials and to prepare the individual pure forms in thin films at ambient conditions.[2] With this method, we prepared high-quality crystal polymorphs and resolved crystal structures of TIPS-pentacene, and performed in situ grazing incidence X-ray diffraction and annealing experiments. The molecular arrangement within the unit cell is determined by a numerical refinement procedure that utilizes the experimental diffraction intensities.

We also used solution shearing to fabricate high performance transparent conducting PEDOT:PSS films. Tunable control of PEDOT backbone orientation, local ordering, and phase separation is demonstrated via precise control of the deposition parameters. Record-high PEDOT:PSS conductivities of 4,600±100 S/cm are obtained and reach a sheet resistance of 17±1 Ω/□ at 97.2±0.4% transmission.[3]

[1] Y. Diao, B. C.-K. Tee, G. Giri, J. Xu, D. H. Kim, H. a Becerril, R. M. Stoltenberg, T. H. Lee, G. Xue, S. C. B. Mannsfeld, and Z. Bao, "Solution coating of large-area organic semiconductor thin films with aligned single-crystalline domains.," *Nat. Mater.* 12, 665 (2013).

[2] Y. Diao, K. M. Lenn, W.-Y. Lee, M. A. Blood-Forsythe, J. Xu, Y. Mao, Y. Kim, J. A. Reinspach, S. Park, A. Aspuru-Guzik, G. Xue, P. Clancy, Z. Bao, and S. C. B. Mannsfeld, "Understanding Polymorphism in Organic Semiconductor Thin Films through Nanoconfinement," *J. Am. Chem. Soc.*, 136(49), 17046 (2014).

[3] B. J. Worfolk, S. C. Andrews, S. Park, J. Reinspach, N. Liu, M. F. Toney, S. C. B. Mannsfeld, and Z. Bao, "Ultrahigh electrical conductivity in solution-sheared polymeric transparent films.," *Proc. Natl. Acad. Sci. U. S. A.* 112 (46), 14138 (2015).

Alle Zuhörer sind ab 15:45 zu Kaffee und Tee vor dem Hörsaal eingeladen.

Informationen zum Vortrag erteilt:
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