Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Probing charge delocalization in a semi-crystalline supramolecular polymer KEEHOON KANG, SHUN WATANABE, KATRINA BROCH, Cavendish Laboratory, University of Cambridge, Cambridge, U.K., DAISUKE MATSUMOTO, KAZUHIRO MARUMOTO, Division of Materials Science, University of Tsukuba, Japan, HISAAKI TANAKA, SHIN-ICHI KURODA, Department of Applied Physics, Nagoya University, Japan, MARTIN HEENEY, Department of Chemistry, Imperial College, London, U.K., HENNING SIRRINGHAUS, Cavendish Laboratory, University of Cambridge, Cambridge, U.K. — Various doping methods have achieved metallic conductivity in π-conjugated polymer but most of them suffer from dopant-induced-disorder. We developed a simple and effective method of doping a high mobility semi-crystalline polymer, poly(2,5-bis(3-hexadecylthiophen-2-yl)thieno[3,2-b]thiophene) (pBTTT) by forming a bi-layer with a small-molecule acceptor, 2,3,5,6-tetrafluoro-7,7,8,8-tetracyanoquinodimethane (F_4-TCNQ). The doping realizes an efficient charge-transfer between pBTTT and F_4-TCNQ (conductivity over 150 S/cm), while preserving the structural order of a pristine pBTTT. The charges are discovered to be sufficiently delocalized to give rise to a nearly-ideal Hall effect, and therefore, a coherent transport in a wide temperature range, with a high Hall mobility of 1.8 cm^2/Vs at room temperature. The combination of a Pauli magnetic susceptibility and magnetoconductance signatures strengthen the evidence of weak localization in the supramolecular system. Comparison with other amorphous conducting polymers elucidates the role of structural order as an indicator of the degree of charge delocalization.

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Date submitted: 14 Nov 2014 Electronic form version 1.4