Stuttgarter Physikalisches Kolloquium

Fachbereich Physik, Universität Stuttgart
Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

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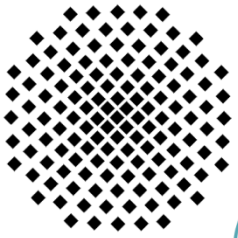

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Charge transport and thermoelectric physics of conjugated polymers at ultrahigh charge densities

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Abstract

The complex charge transport physics of conjugated polymers has been studied intensively since the Nobel Prize winning discovery of the electrical conduction in doped polyacetylene by Heeger, MacDiarmid and Shirakawa in 1977. At low charge densities < 1018-1019 cm-3, that are relevant for light-emitting diodes, solar cells or field-effect transistors, the charge transport physics of conjugated polymers is governed by static energetic disorder caused by structural heterogeneity and dynamic disorder due to molecular vibrations. However, organic electrochemical transistors (OECTs) and thermoelectric converters are examples of organic devices that operate at much higher charge carrier concentrations on the order of 1020-1021 cm3 approaching the density of molecular units. Understanding the charge transport in this regime, where the repulsive Coulombic electron-electron interactions and the attractive interactions between the mobile charge carriers and the charge-balancing counterions need to be considered, poses new challenges. In this presentation we will provide an overview over the current understanding of the key factors that govern charge transport in this ultrahigh carrier density regime and give examples of how better fundamental understanding of the relevant transport physics can lead to significant enhancements in the charge transport and thermoelectric properties of these materials.