

先进材料超微结构与超快过程研究所

Institute of Super-microstructure and Ultrafast Process in Advanced Materials

省重点实验室学术报告 (16)

Electronic conduction properties of indium tin oxide: single-particle and many-body transport

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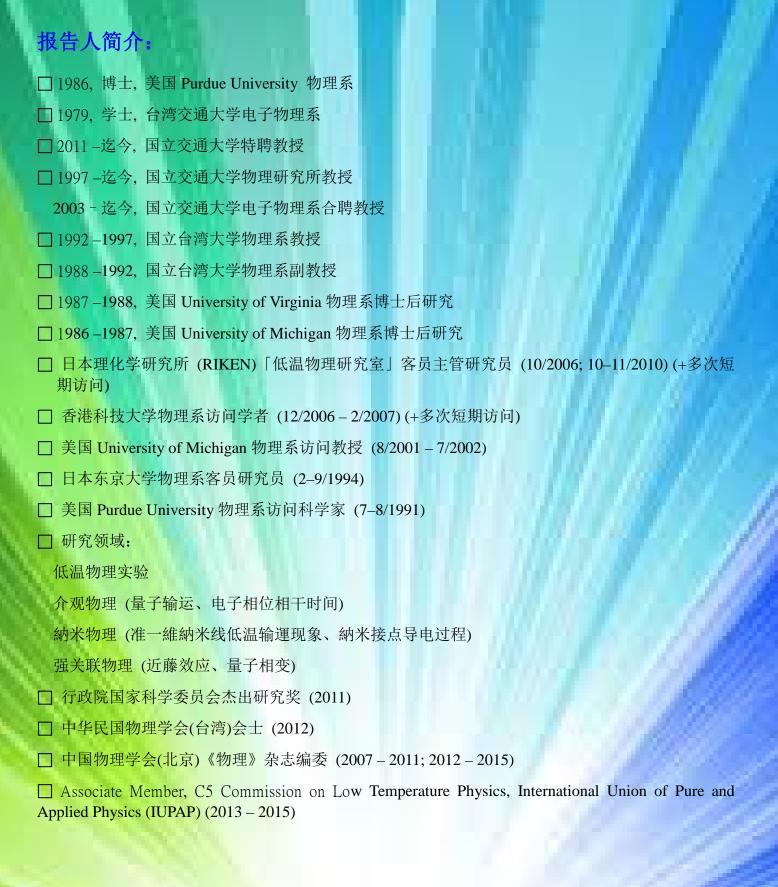
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报告摘要:

Indium tin oxide (Sn-doped In2O3- or ITO) is a very interesting and technologically important transparent conducting oxide. This class of material has been extensively investigated for decades, with research efforts mostly focusing on the application aspects. The fundamental issues of the electronic conduction properties of ITO from room temperature down to liquid-helium temperatures have rarely been addressed thus far. Studies of the electrical-transport properties over a wide range of temperature are essential to unraveling the underlying electronic dynamics and microscopic electronic parameters. In this talk, we show that one can learn rich physics in ITO material, including the semi-classical Boltzmann transport, quantum-interference electron transport, as well as the many-body Coulomb electron-electron interaction effects in the presence of disorder and inhomogeneity (granularity). To fully reveal the numerous avenues and unique opportunities that the ITO material has provided for fundamental condensed matter physics research, we demonstrate a variety of charge transport properties in different forms of ITO structures, including homogeneous polycrystalline thin and thick films, homogeneous single-crystalline nanowires, and inhomogeneous ultrathin films. In this manner, we not only address new physics phenomena that can arise in ITO but also illustrate the versatility of the stable ITO material forms for potential technological applications. We emphasize that, microscopically, the novel and rich electronic conduction properties of ITO originate from the inherited robust free-electron-like energy bandstructure and low-carrier concentration (as compared with that in typical metals) characteristics of this class of material. Furthermore, a low carrier concentration leads to slow electron-phonon relaxation, which in turn causes the experimentally observed (1) a small residual resistance ratio, (2) a linear electron diffusion thermoelectric power in a wide temperature range 1-300 K, and (3) a weak electron dephasing rate. We focus our discussion on the metallic-like ITO material

Reference:

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