中南大學 物理与电子学院
School of Physics and Electronics, Central South University
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

报告人： **Juhn-Jong Lin**（林志忠）， 教授 （NCTU-RIKEN Joint Research Laboratory, Institute of Physics and Department of Electrophysics, National Chiao Tung University **Taiwan**）

Email: jjlin@mail.nctu.edu.tw

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, the 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:

J. J. Lin and Z. Q. Li, *Electronic conduction properties of indium tin oxide: single-particle and many-body transport*, J. Phys.: Condens. Matter **26**, 343201 (2014). (Topical Review)

报告人简介：

- ☐ 1986，博士，美国 Purdue University 物理系
- ☐ 1979，学士，台湾交通大学电子物理系
- ☐ 2011 –迄今，国立交通大学特聘教授
- ☐ 1997 –迄今，国立交通大学物理研究所教授

  2003－迄今，国立交通大学电子物理系合聘教授
- ☐ 1992 –1997，国立台湾大学物理系教授
- ☐ 1988 –1992，国立台湾大学物理系副教授
- ☐ 1987 –1988，美国 University of Virginia 物理系博士后研究
- ☐ 1986 –1987，美国 University of Michigan 物理系博士后研究
- ☐ 日本理化学研究所（RIKEN）「低温物理研究室」客员主管研究员（10/2006; 10–11/2010) (+多次短期访问)
- ☐ 香港科技大学物理系访问学者（12/2006 – 2/2007) (+多次短期访问)
- ☐ 美国 University of Michigan 物理系访问教授（8/2001 – 7/2002)
- ☐ 日本东京大学物理系客员研究员（2–9/1994)
- ☐ 美国 Purdue University 物理系访问科学家（7–8/1991)
- ☐ 研究领域：

  低温物理实验

  介观物理（量子输运、电子相位相干时间)

  納米物理（准一維納米线低温输運现象、納米接点导电过程)

  强关联物理（近藤效应、量子相变)
- ☐ 行政院国家科学委员会杰出研究奖（2011)
- ☐ 中华民国物理学会(台湾)会士（2012)
- ☐ 中国物理学会(北京)《物理》杂志编委（2007 – 2011; 2012 – 2015)
- ☐ Associate Member, C5 Commission on Low Temperature Physics, International Union of Pure and Applied Physics (IUPAP) (2013 – 2015)

报告时间：2014 年 9 月 24 日 (星期三) 上午 10:30

报告地点：南校区双超楼 211 报告室

联 系 人：孟建桥 教授