北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Molecular-beam epitaxy and superconductivity of infinite-layer cuprate films

马旭村（清华大学物理系）

Time: 3:00 pm, Mar.26, 2025 (Wednesday)

时间：2025年3月26日（周三）下午3:00

Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Cuprate superconductivity emerges in the copper oxide plane by doping the charge reservoir layers, while the undoped copper oxide is well known as a Mott insulator. How the carriers are transferred from the doped charge reservoir layers into the intact CuO_2 planes remains to be elucidated. In 2012 we discovered the interface-enhanced superconductivity in single unit-cell FeSe/$SrTiO_3$ system and also pointed out that the high transition temperature of the layered cuprates may very likely result from a single unit cell of the material. Meanwhile, in order to unravel the underlying physics in cuprate superconductors, it is highly tempting to investigate directly the copper oxide plane in experiment.

Among all cuprate compounds infinite-layer cuprates have the simplest crystal structure and also can be prepared with a CuO_2-terminated surface. For such purposes, we have successfully prepared high quality of $Sr_{1-x}Ln_xCuO_2$ (Ln = La, Nd, Eu) infinite-layer films with controlled electron (by trivalent lanthanide) and hole (by apical oxygen) carriers via oxide molecular-beam epitaxy. The real space visualization of the copper oxide plane upon doping reveals a systematic shift in the Fermi level, while the fundamental Mott-Hubbard band structure remains unchanged. Transport measurements reveal the two-dimensional nature of superconductivity in $Sr_{1-x}Ln_xCuO_2$ films. The enhancement in superconducting transition temperature may benefit from a combined density of states from both electronlike and holelike pockets of the films. The results set the stage for further advancements in our understanding of cuprate superconductivity.

About the speaker

马旭村，清华大学物理系研究员，主要研究方向是低维量子材料的外延生长与性质，近期工作集中在界面超导、铜氧化物薄膜高温超导研究。曾获得中国科学院杰出科技成就集体奖（2005、2011）、国家自然科学二等奖（2011）、“求是”杰出科技成就集体奖（2011）、陈嘉庚科学奖（2012）、国家自然科学一等奖（2018）等，入选第三批国家“万人计划”科技创新领军人才等。