复旦大学物理系 物质科学报告

Time: 2:00pm, Tuesday, 2017.9.12

Location：Physics Building, Room 221B

Tunable Superconductivity and Phase Transitions by Field Effect Transistor

Xianhui Chen

Department of Physics, University of Science and Technology of China

In the field effect transistor (FET), electric field is adopted to control physical performance via tuning the carrier density. Such controllability through an electrostatic doping greatly promotes the development of research and industry for semiconductors. However, conventional metal-insulator-semiconductor (MIS) FET can only sustain very limited carrier density, and cannot meet further demands, especially in exploring high temperature superconductivity. Consequently, researchers attempt to seek for FET with new gate dielectric, such as the electric double layer FET (EDL-FET) based on liquid ions to break this bottleneck. In this talk, we report high temperature superconductivity with an onset above 40 K can be achieved in an FeSe thin flake with T_c less than 10 K by tuning carrier with this EDL-FET technique. We also report on a novel FET device using solid ion conductor (SIC) as a gate dielectric, developed by our group, to overcome the inherent drawbacks of both MIS- and EDL-FET devices. Based on this SIC-FET technique, we achieved an optimal Tc of 46.6 K in FeSe thin flakes. In contrast to the EDL-FET based on liquid ion dielectric, SIC-FET can tune carrier concentration in a wider range, so that the complete phase diagram of FeSe superconductor can be mapped out. An superconductivity- insulating state transition is observed. Two new structural phases of $Li_xFe_2Se_2$ are obtained due to the Li intercalation driven by electrical field. A discrete superconducting phase diagram is observed in Li_xFeSe system. We also study the phase diagram of $FeSe_{0.5}Te_{0.5}$ and Bi_2Se_3 using SIC-FET. It is found that the phase diagram of $FeSe_{0.5}Te_{0.5}$ is quite different from that of FeSe because substitution of Te for Se may leads to a change of nature of FeSe layer. We will show you the evolution of topological insulator to superconductor for Bi_2Se_3 by the gating with SIC-FET.

陈仙辉，1963 年 3 月生于湖南湘潭，中国科学院院士，中国科学技术大学和上海研究院教授，博士生导师，中科院强耦合量子材料物理重点实验室主任。主要从事超导、量子功能材料和强关联电子体系的实验研究。已发表 SCI 论文 300 余篇，论文引用 13000 余次，其中两篇论文引用超过千次（1600 和 1300 余次），发表论文包括 Science（1 篇）、Nature（3 篇）、Nature Materials（3 篇）、Nature Nanotechnology（6 篇）、Nature Physics（2 篇）、Nature Communications（6 篇）、Nature Photonics（1 篇）和 PRL（35 篇）等。作为项目负责人承担了国家自然科学基金重大项目、重点项目、面上项目、联合项目、科技部重大研究计划和重大专项项目、中科院战略先导 B 类专项等研究课题。1998 年 获国家自然科学基金委杰出青年基金资助； 2003 年 获聘“长江学者奖励计划特聘教授”； 2008 年教育部-李嘉诚基金会长江学者成就奖；2009 年 获中国物理学会一叶企孙奖；2009 年 获香港求是科技基金会一求是杰出科技成就集体奖；2013 年 获国家自然科学一等奖；2015 年 获国际超导材料最高奖 Bernd T. Matthias 奖