Electronic Transport and Device Applications of 2D Materials

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Venue: w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

During the last decade, tremendous research efforts have been focused on two-dimensional (2D) materials due to their rich physics and great potentials for many applications. Our group is now focusing on electronic transport, electro-mechanical properties, optoelectronic properties, and related device applications of various 2D materials, as well as their van der Waals heterostructures. The first part of my talk will focus on the electro-mechanical properties of suspended graphene, which is the thinnest flexible conductive material. I will present the positive piezoconductive effect we observed in suspended bi- and multi-layer graphene. The effect is highly layer-dependent, with the most pronounced response for tri-layer graphene. The effect, and its dependence on the layer number, can be understood as resulting from the strain-induced competition between interlayer coupling and intralayer hopping, as confirmed by the numerical calculation based on the non-equilibrium Green's function method. [1]

The second part of the talk will cover our recent studies on atomically thin rhenium disulfide (ReS_2) flakes with unique distorted 1T structure, which exhibit interesting in-plane anisotropic transport and mechanical properties, as well as excellent optoelectronic properties. We fabricated mono- and few-layer ReS_2 field effect transistors, which exhibit competitive performances and record-high anisotropic ratio among all known 2D semiconducting materials. We further successfully demonstrated an integrated digital inverter with good performance by utilizing two ReS_2 anisotropic field effect transistors, suggesting the promising implementation of large-scale two-dimensional logic circuits. [2] Our latest results on the ultra-high responsivity phototransistors based on few-layer ReS_2 and broadband photovoltaic detectors based on an atomically thin heterostructure will also be presented. [3,4]

[1] Xu, *et al*. "The positive piezoconductive effect in graphene", ***Nat. Comm.*** 6, 8119 (2015).
[2] Liu, *et al*. "Integrated Digital Inverters Based on Two-dimensional Anisotropic ReS_2 Field-effect Transistors", ***Nat. Comm.*** 6, 6991 (2015).
[3] Liu, *et al*. "Ultra-high responsivity phototransistors based on few-layer ReS_2 for weak signal detection", ***Adv. Func. Mater.*** (2016) (in press).
[4] Long, *et al*. "Broadband photovoltaic detectors based on an atomically thin heterostructure", ***Nano Lett.*** (2016) (in press).

About the Speaker

缪峰,南京大学物理学院和南京微结构国家实验室教授、博士生导师。2000-2004年在南京大学物理系学习，获理学学士学位；2004-2009年，美国加州大学河滨分校博士研究生，2009年获博士学位，并获最佳博士毕业生奖和国家优秀自费留学生奖；2009-2012年在美国惠普实验室（硅谷总部）任助理研究员；2012年入选国家"青年千人计划"，同年全职回南京大学工作；2014年获江苏省杰出青年基金资助；现任科技部"量子调控"国家重大科学研究计划（青年科学家专题）项目首席科学家。主要从事石墨烯、过渡金属硫族化合物为代表的新型低维材料的低温电子输运、光电性质、机械性能等基本物性的研究，以及相关功能电子器件在信息存储、逻辑运算、传感器等领域的应用基础研究。在石墨烯的电子弹道输运、超导电流传输、悬浮石墨烯的机电性质、基于硫化铼的场效应及逻辑器件、忆阻器(memristor)的工作机制及材料设计等研究上取得了一系列创新成果，多项工作在国际同行中产生重要影响。作为第一作者或通讯作者在*Science*、*Nature*子刊、*Physical Review Letters*、*Advanced Materials*、*Nano Letters*等国际权威学术期刊上发表论文，共发表SCI论文40余篇，总引用7300余次；并申请新型材料及电子器件相关美国专利8项（已获授权5项），中国专利4项。