Electronic Transport and Device Applications of 2D Materials

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报告摘要：

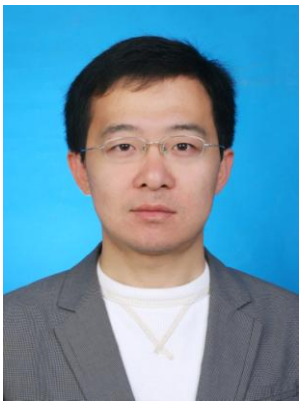
During the last decade, tremendous research efforts have been focused on two-dimensional (2D) materials due to their rich physics and great potentials for many applications. Our group at Nanjing University is now focusing on electronic transport, electro-mechanical properties, optoelectronic properties, and related device applications of various 2D materials. 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 transition-metal dichalcogenides (TMD) with low lattice symmetry. In a predicted type-II Weyl semimetal (WSM) material, tungsten ditelluride (WTe_2), we observed notable angle-sensitive negative longitudinal magnetoresistance (MR) and the strong planar orientation dependence which reveal important transport signatures of chiral anomaly. By applying a gate voltage, we further demonstrated that the Fermi energy can be tuned through the Weyl points via the electric field effect; this is the first report of controlling the unique transport properties *in situ* in a WSM system. [2] We also studied atomically thin rhenium disulfide (ReS_2) flakes exhibiting 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. We further successfully demonstrated an integrated digital inverter with good performances by utilizing two ReS_2 anisotropic field effect transistors, suggesting the promising implementation of large-scale two-dimensional logic circuits. [3] 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. [4,5]

References：

[1] Xu, *et al*. "The positive piezoconductive effect in graphene", ***Nat. Comm.*** 6, 8119 (2015).
[2] Wang, *et al*. "Gate-Tunable Negative Longitudinal Magnetoresistance in the Predicted Type-II Weyl Semimetal WTe2", ***Nat. Comm.*** 7, 13142 (2016).
[3] Liu, *et al*. "Integrated Digital Inverters Based on Two-dimensional Anisotropic ReS_2 Field-effect Transistors", ***Nat. Comm.*** 6, 6991 (2015).
[4] Liu, *et al*. "Ultra-high responsivity phototransistors based on few-layer ReS_2 for weak signal detection", ***Adv. Func. Mater.*** 26, 1938 (2016).
[5] Long, *et al*. "Broadband photovoltaic detectors based on an atomically thin heterostructure", ***Nano Lett.*** 16, 2254 (2016).

报告人简介：



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，国家杰出青年科学基金获得者，科技部国家重大科学研究计划青年项目首席科学家，国家青年千人计划入选者。2004 年本科毕业于南京大学物理系，2009 年获美国加州大学河滨分校物理学博士学位，同年获得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后全职回南京大学工作。主要从事二维材料的电子输运研究，以及它们在信息器件领域的应用研究。在石墨烯电子弹道输运、过渡金属硫族化合物电子输运、二维材料场效应晶体管及逻辑器件、忆阻器(memristor)器件物理等研究上取得了一系列创新成果。作为第一作者或通讯作者在 Science、Nature 子刊、Phys. Rev. Lett.等国际权威学术期刊上发表论文，共发表 SCI 论文 50 余篇，总引用 8800 余次；已获授权美国专利 8 项，申请中国专利 5 项。目前担任 Scientific Reports 和 npj 2D Materials and Applications 的编委和 Nature Nano.、Nature Comm.、Adv. Mater.、Nano Lett.等学术期刊的特约审稿人。

报告时间：2017 年 1 月 6 日（星期五）下午 2:30~4:00

报告地点：南校区超微超快所 211 会议室

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