北京大学量子材料科学中心

International Center for Quantum Materials, PKU

# Electronic Transport and Device Applications of 2D Materials

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**Time: 10:00am, July 11, 2016 (Monday)**

**时间: 2016年7月11日 （周一）上午10:00**

**Venue: w563, Physics building, Peking University**

**地点：北京大学物理楼，西563会议室**

## Abstract

Two-dimensional materials exhibit diverse electronic properties, ranging from metallic graphene and semiconducting transition metal dichalcogenides such as molybdenum disulphide, to insulating hexagonal boron nitride [1]. In this talk, I will first address the physics of light-graphene interaction within the single-electron framework, followed by a discussion of light excitation of collective oscillations of the carriers, i.e., plasmons in graphene. I will focus on the unique graphene plasmonic properties arising from its “massless” carriers [2-3]. Then I will briefly cover the advantages and disadvantages of semiconducting transition metal dichalcogenides in optoelectronics and electronics if compared with graphene. Finally I will discuss a few promising future research directions using recently rediscovered black phosphorus [4-6], which serendipitously bridges the zero-gap graphene and the relatively large-bandgap transition metal dichalcogenides such as molybdenum disulfide ($MoS_2$).

1. F. Xia, H. Wang, D. Xiao, M. Dubey, and A. Ramasubramaniam, “Two-dimensional material nanophotonics,” ***Nature Photonics*** 8, 899-907 (2014).
2. H. Yan, X. Li, B. Chandra, G. Tulevski, Y. Wu, M. Freitag, W. Zhu, P. Avouris, and F. Xia, “Tunable infrared plasmonic devices using graphene/insulator stacks,” ***Nature Nanotechnology*** 7, 330-334 (2012).
3. H. Yan, T. Low, W. Zhu, Y. Wu, M. Freitag, X. Li, F. Guinea, P. Avouris, and F. Xia, “Damping pathways of mid-infrared plasmons in graphene nanostructures,” ***Nature Photonics*** 7, 394-399 (2013).
4. H. Wang, X. Wang, F. Xia, L. Wang, H. Jiang, Q. Xia, M. L. Chin, M. Dubey, and S.-J. Han, “Black Phosphorus Radio-Frequency Transistors,” ***Nano Letters*** 14, 6424–6429 (2014).
5. X. Ling, H. Wang, S. Huang, F. Xia, and M. S. Dresselhaus, “The renaissance of black phosphorus,” ***Proceedings of the National Academy of Sciences*** 112, 4523-4530 (2015).
6. X. Wang, A. M. Jones, K. L. Seyler, V. Tran, Y. Jia, H. Zhao, H. Wang, L. Yang, X. Xu, and F. Xia, “Highly Anisotropic and Robust Excitons in Monolayer Black Phosphorus,” ***Nature Nanotechnology*** 10, 517–521 (2015).

## About the Speaker

Fengnian Xia received the B.E. degree with highest honor in electronics engineering from Tsinghua University, Beijing, China, in 1998 and M.A. and Ph.D. degrees in electrical engineering from Princeton University, Princeton, NJ, USA in 2001 and 2005, respectively. He joined IBM Thomas J. Watson research center in Yorktown Heights, NY, USA as a postdoc in March 2005, and was a Research Staff Member before he started at Yale University in September 2013. Currently he is the Barton L. Weller associate professor in engineering and science in Department of Electrical Engineering. He currently explores the light-matter interaction and quantum transport in these low-dimensional materials and also identifies their potential applications in computing, flexible electronics, imaging, optical communications, and energy harvesting.

Professor Xia’s honors include the National Science Foundation CAREER award (2016), the Office of Naval Research Young Investigator Award (2015), the IBM Pat Goldberg Memorial Best Paper Award (2014), the TR35 Award, MIT Technology Review’s Top Young Innovators under 35 (2011), the IBM Corporate Award, that corporation’s highest technical honor (2012), and the designation of the Weller Junior Professorship in Engineering and Science by Yale President in October 2015.