



THE CHINESE UNIVERSITY OF HONG KONG
Department of Physics
SEMINAR

Piezotronics and Piezo-phototronics

by

Professor Zhong Lin WANG (王中林教授)
School of Materials Science and Engineering
Georgia Institute of Technology, USA
&
Beijing Institute of Nanoenergy and Nanosystems
Chinese Academy of Sciences, China

Date: November 23, 2016 (Wednesday)

Time: 4:30 - 6:00 p.m.

Place: L2, Science Centre, CUHK

ALL INTERESTED ARE WELCOME

Abstract

Piezoelectricity, a phenomenon known for centuries, is an effect that is about the production of electrical potential in a substance as the pressure on it changes. For wurtzite structures such as ZnO, GaN, InN and ZnS, due to the polarization of ions in a crystal that has non-central symmetry, a piezoelectric potential (piezopotential) is created in the crystal by applying a stress. The effect of piezopotential to the transport behavior of charge carriers is significant due to their multiple functionalities of piezoelectricity, semiconductor and photon excitation. By utilizing the advantages offered by these properties, a few new fields have been created. Electronics fabricated by using inner-crystal piezopotential as a “gate” voltage to tune/control the charge transport behavior is named piezotronics, with applications in strain/force/pressure triggered/controlled electronic devices, sensors and logic units. This effect was also extended to 2D materials such as MoS₂. Piezo-phototronic effect is a result of three-way coupling among piezoelectricity, photonic excitation and semiconductor transport, which allows tuning and controlling of electro-optical processes by strain induced piezopotential. The objective of this talk is to introduce the fundamentals of piezotronics and piezo-phototronics and to give an updated progress about their applications in energy science (LED, solar) and sensors (photon detector and human-CMOS interfacing).

- [1] W.Z. Wu, X.N. Wen, Z.L. Wang “Pixel-addressable matrix of vertical-nanowire piezotronic transistors for active/adaptive tactile imaging”, *Science*, 340 (2013) 952-957.
- [2] C.F. Pan, L. Dong, G. Zhu, S. Niu, R.M. Yu, Q. Yang, Y. Liu, Z.L. Wang “Micrometer-resolution electroluminescence parallel-imaging of pressure distribution using piezoelectric nanowire-LED array”, *Nature Photonics*, 7 (2013) 752-758.
- [3] Z.L. Wang “Piezopotential Gated Nanowire Devices: Piezotronics and Piezo-phototronics”, *Nano Today*, 5 (2010) 540-552.
- [4] Q. Yang, W.H. Wang, S. Xu and Z.L. Wang “Enhancing light emission of ZnO microwire-based diodes by piezo-phototronic effect”, *Nano Letters*, 11 (2011) 4012-4017.
- [5] W.Z. Wu, L. Wang, Y.L. Li, F. Zhang, L. Lin, S. Niu, D. Chenet, X. Zhang, Y. Hao, T.F. Heinz, J. Hone, and Z.L. Wang “Piezoelectricity of single-atomic-layer MoS₂ for energy conversion and piezotronics”, *Nature*, 514 (2014) 470-474.