

ZERNIKE INSTITUTE COLLOQUIUM

Thursday, February 6th, 2014

16:00h, Lecture Hall: 5111.0080

Coffee and cakes from 15:30h

Nanogenerators as new energy technology and piezotronics for functional systems

Zhong Lin Wang
School of Materials Science and Engineering
Georgia Institute of Technology
Atlanta, USA



Developing wireless nanodevices and nanosystems is of critical importance for sensing, medical science, environmental/infrastructure monitoring, defense technology and even personal electronics. It is highly desirable for wireless devices to be self-powered without using battery. Nanogenerators (NGs) have been developed based on piezoelectric, triboelectric and pyroelectric effect, aiming at building self-sufficient power sources for micro/nano-systems. The output of the nanogenerators now is high enough to drive a wireless sensor system and charge a battery for a cell phone, and they are becoming a vital technology for sustainable, independent and maintenance free operation of micro/nano-systems and mobile/portable electronics. This talk will focus on the fundamentals and novel applications of NGs.

For Wurtzite and zinc blend structures that have non-central symmetry, such as ZnO, GaN and InN, a piezoelectric potential (piezopotential) is created in the crystal by applying a strain. Such piezopotential can serve as a “gate” voltage that can effectively tune/control the charge transport across an interface/junction; electronics fabricated based on such a mechanism is coined as piezotronics, with applications in force/pressure triggered/controlled electronic devices, sensors, logic units and memory. By using the piezotronic effect, we show that the optoelectronic devices fabricated using wurtzite materials can have superior performance as solar cell, photon detector and light emitting diode. Piezotronics is likely to serve as a “mechanosensation” for directly interfacing biomechanical action with silicon based technology and active flexible electronics. This lecture will focus on the fundamental science and novel applications of piezotronics in sensors, touch pad technology, functional devices and energy science.

References

1. “Nanogenerators for self-powered systems”, <http://hdl.handle.net/1853/39262>
2. Sihong Wang, Long Lin, Yannan Xie, Qingshen Jing, Simiao Niu, Zhong Lin Wang “Sliding-Triboelectric Nanogenerators Based on In-Plane Charge-Separation Mechanism”, *Nano Letters*, 13 (2013) 2226–2233.
3. Guang Zhu, Caofeng Pan, Wenxi Guo, Chih-Yen Chen, Yusheng Zhou, Ruomeng Yu, Zhong Lin Wang “Triboelectric-generator-driven pulse electrodeposition for micro-patterning”, *Nano Letters*, 12 (2012) 4960 – 4965.
4. “Piezotronics and Piezo-phototronics”, Z.L. Wang, Springer, 2013.
5. Wenzhuo Wu, Xiaonan Wen, Zhong Lin Wang “Pixel-addressable matrix of vertical-nanowire piezotronic transistors for active/adaptive tactile imaging”, *Science*, 340 (2013) 952-957.
6. Caofeng Pan, Lin Dong, Guang Zhu, Simiao Niu, Ruomeng Yu, Qing Yang, Ying Liu, Zhong Lin Wang “Micrometer-resolution electro-luminescence parallel-imaging of pressure distribution using piezoelectric nanowire-LED array”, *Nature Photonics*, 7 (2013) 752-758.



university of
 groningen

zernike institute for
 advanced materials