

Nanogenerators as new energy technology and piezotronics for functional systems

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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. “Piezotronics and Piezo-phototronics”, Z.L. Wang, Springer, 2013.

About speaker:

Dr. Zhong Lin (ZL) Wang received his PhD from Arizona State University in transmission electron microscopy. He now is the Hightower Chair in Materials Science and Engineering, Regents' Professor, Engineering Distinguished Professor and Director, Center for Nanostructure Characterization, at Georgia Tech. Dr. Wang has made original and innovative contributions to the synthesis, discovery, characterization and understanding of fundamental physical properties of oxide nanobelts and nanowires, as well as applications of nanowires in energy sciences, electronics, optoelectronics and biological science. His discovery and breakthroughs in developing nanogenerators establish the principle and technological road map for harvesting mechanical energy from environment and biological systems for powering a personal electronics. His research on self-powered nanosystems has inspired the worldwide effort in academia and industry for studying energy for micro-nano-systems, which is now a distinct disciplinary in energy research and future sensor networks. He coined and pioneered the field of piezotronics and piezo-phototronics by introducing piezoelectric potential gated charge transport process in fabricating new electronic and optoelectronic devices. This breakthrough by redesign CMOS transistor has important applications in smart MEMS/NEMS, nanorobotics, human-electronics interface and sensors. Dr. Wang's publications have been cited for over 56,000 times. The H-index of his citations is 114. Dr. Wang was elected as a foreign member of the Chinese Academy of Sciences in 2009, member of European Academy of Sciences in 2002, fellow of American Physical Society in 2005, fellow of AAAS in 2006, fellow of Materials Research Society in 2008, fellow of Microscopy Society of America in 2010, and fellow of the World Innovation Foundation in 2002. He is an honorable professor of over 10 universities in China and Europe. He received 2012 Edward Orton Memorial Lecture Award from American Ceramic Society, 2011 MRS Medal from the Materials Research Society, 1999 Burton Medal from Microscopy Society of America, 2001 S.T. Li prize for Outstanding Contribution in Nanoscience and Nanotechnology, and the 2009 Purdy Award from American Ceramic Society. Details can be found at: <http://www.nanoscience.gatech.edu>

