The Science and Technology of Nanogenerators and Piezotronics

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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, without which most of the sensor network may be impossible. The piezoelectric nanogenerators developed by us have the potential to serve as self-sufficient power sources for mico/nano-systems. For Wurtzite 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. The *nanogenerator* is invented by using the piezopotential as the driving force for electrons to flow in responding to a dynamic straining of piezoelectric nanowires [1-5]. A gentle straining can produce an output voltage of up to 20-40 V from an integrated nanogenerator. Furthermore, piezopotential in the wurtzite structure 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 *piezotronicsI [6-8]*, with applications in force/pressure triggered/controlled electronic devices, sensors, logic units and memory. By using the piezotronic effect, we show that the optoelectronc devices fabricated using wurtzite materials can have superior performance as solar cell, photon detector and light emitting diode [9-11]. Piezotronic is likely to serve as a "mediator" for directly interfacing biomechanical action with silicon based technology.

This lecture will cover the basic mechanism that governs the operations of nanogenerators and piezotronics, the associated engineering-scale, and practical applications. The aim is to give a comprehensive introduction of how to develop a basic scientific idea into a practically applicable technology while preserve the original creativity and originality.

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