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Nanogenerator and Nanomemory Based on ZnO Nanowire

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Developing wireless nanodevices and nanosystems is of critical importance for sensing, medical science, defense technology, and even personal electronics. A nanosystem requires a nano-power source to make the entire package extremely small. It is essential to explore innovative nanotechnologies for converting mechanical energy (such as body movement, muscle stretching), vibrational energy (such as acoustic or ultrasonic waves), and hydraulic energy (such as body fluid flow) into electrical energy, which will be used to power nanodevices without a battery. In this presentation, the nanowire-based nanogenerator,[1] which can harvest mechanical energy from the environment, is systematically described. The working mechanism of the nanogenerator relies on the unique semiconducting and piezoelectric coupled properties of ZnO.

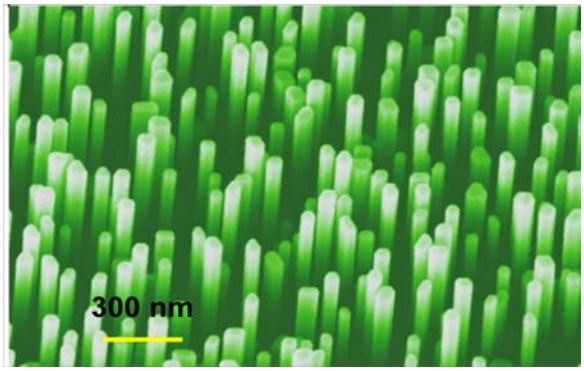

Figure 1. ZnO nanowire arrays growth on GaN substrate with diameters are around 50 nm and 300 nm to 2 micrometer in length.

On the other hand, ferroelectric random access memory is attracting a great interest both in scientific research and industry applications for its low power consumption, faster reading/writing speed, and extremely large writing-erasing cycles compared to other memory technologies, such as capacitors and transistor-coupled units made by lithography technique on silicon wafers. The advantages come from the spontaneous polarization dipoles in the cells of ferroelectric materials, which can be rapidly reversed by an electric field. However, as the size of a memory unit shrinks to submicrometer scale, the ferroelectric material would lose its ferroelectric property due to the surface screening effect, resulting in lower storage density. As the traditional random access memory reaches the limit of the metal_oxide_semiconductors, searching for new approach for fast reading-rewriting and high density memory technology is important for the development of information technology. Here, we report a

new memory device[2] fabricated using single crystal ZnO nanowires based on a different working mechanism, which preserves hysteresis in I_V curve from 100 Hz to 10 kHz (theoretically to GHz) ranges and could be an ideal technique for developing ultrafast, high density data storages.

My presentation will focus on the first nanogenerator principle based on ZnO nanowire arrays by using conductive AFM, the development of high density fast data storage nanodevice based on single ZnO nanowire.

[1] Z.L. Wang and Jinhui Song "Piezoelectric Nanogenerators Based on Zinc Oxide Nanowire Arrays", *Science*, **2006**, (312), 242-246

[2] Jinhui Song, Yan Zhang, Chen Xu, Wenzuo Wu and Zhong Lin Wang, "Polar Charges Induced Electric Hysteresis of ZnO Nano/Microwire for Fast Data Storage", *Nano Lett.*, **2011**, *11* (7), pp 2829–2834