Photoconductivity of Single Crystal ZnO Nanowires

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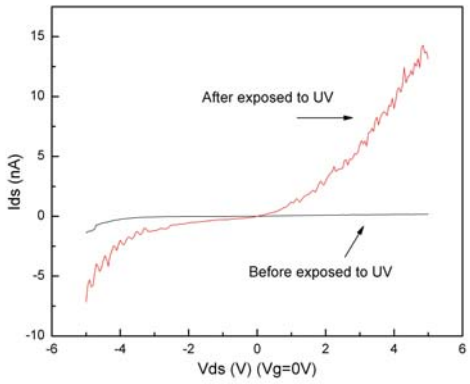
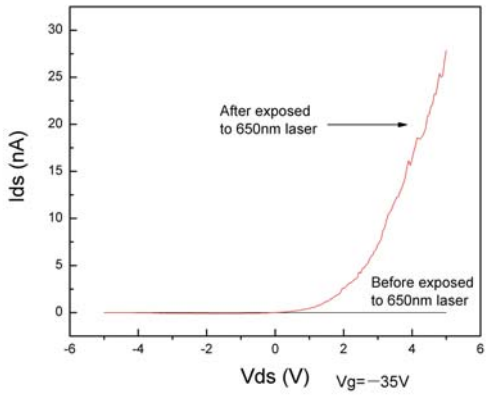
II-VI compound semiconductor ZnO nanowires have intrigued intensive interest for their potential application in building nanoscale optoelectronic devices. In our work, a simple chemical vapor deposition method was used to synthesize single crystal ZnO nanowires. Electrical transport studies showed their typical *n*-type behavior. UV (370nm) and red laser (650nm) have been used to study their photoconductivity and optoelectronic switch applications.

During synthesis, a quartz bolt contained Zn metal powder was placed into a furnace, adjacent to a silicon chip deposited with gold nanoparticles as catalyst. The furnace was heated up to 700 ºC, flown with oxygen mixture gas. Afterwards, nanowires were then dispersed into IPA solvent. SEM shows the nanowires have diameter 30-100nm. High resolution TEM image and selected area electron diffraction pattern reveal that the nanowires were grown along [001] direction. ZnO nanowire suspension was deposited on a *p*-type degenerately doped silicon wafer with 500nm oxide layer. Photolithography followed by metallization was used to fabricate contact electrodes onto nanowires. Using silicon wafer as back gate, three terminal measurements clearly demonstrate their *n*-type behavior.

UV detection (370nm) using ZnO nanowires had been reported by Yang *et al* [1], however, the response speed was low (~1s), and photocurrent caused by longer wavelength has not yet been investigated. In our experiments, ZnO nanowires devices showed quite pronounced response to red laser (650nm) (left figure below) as well as UV (370nm) (right figure). In addition, the devices respond to 650nm laser and 370nm UV with faster speed than reported.





Reference:

[1] H. Kind, H. Yan, B. Messer, M. Law, P. Yang, *Adv. Mater.* 14 (2) 158 (2002).