AbstractID: 3810 Title: Novel ZnO Nanotips: Potential Nanomaterials for New Generation of Radiation Detectors

Purpose: Current dosimetry technology is limited by large detector size (ion chambers), complex handling processes (TLDs), energy dependent and limited dynamic range (films), and thermal noise and low sensitivity (narrow bandgap semiconductor-based dosimeters). Wide bandgap materials have lower background carrier concentration and better temperature stability. ZnO is an emerging wide bandgap semiconductor with a direct bandgap Eg~3.30 eV at room temperature. ZnO is biocompatible and significantly more radiation-hard than Si, GaAs, or GaN. Thus, nanoscale ZnO is particularly suitable for long term *in vivo* therapeutic X-ray and γ–ray measurements. Here, we report our preliminary investigations of ZnO nanotips for potential medical dosimetry applications.

Method and Materials: High-quality ZnO nanotips were grown on Si substrates by metal-organic chemical vapor deposition. The as-grown ZnO nanotip samples (n=20) were irradiated using 6 MV, 15 MV, 9 MeV, and 20 MeV photon and electron beams on a VARIAN CLINAC 21EX. The irradiated samples were analyzed using X-ray diffraction (XRD), field emission scanning electron microscopy (SEM), photoluminescence spectroscopy (PLS), and sheet resistance measurements to characterize the radiation effects.

Results: Irradiated ZnO nanotips were found to exhibit identical morphology and functionality as the as-grown ones without observable lattice damage or defect. XRD data showed no change in the intensity or the full width at half maximum (FWHM) of the peaks. The nanotips maintained the primary c-axis orientation, further peaks other than ZnO (002) – (004) doublet and substrate Si (400) were not observed, indicating absence of secondary phase formation or change in structure. Particularly, they maintained good electrical, optical, and crystal properties, the key to make X-ray and γ–ray detectors based on ZnO nanotips.

Conclusions: ZnO nanotips are a promising new generation of nanomaterials with great potentials in nano-electronics, nano-photonics, high-resolution real-time *in vivo* dosimetry, integrated dose measurement by implantation, and microbeam calibration and profiling.