Contribution ID: **124** Type: **Poster**

The ZnO Nanowires in AAO Membrane as a Novel High Spatial Resolution Position Sensitive X-ray Detector

Thursday 7 September 2017 14:10 (20 minutes)

The spatial resolution of an indirect x-ray imaging detector is degraded by the light spreading phenomenon in a scintillation layer. In a position sensitive detector with a thicker x-ray converter, for improving the spatial resolution, microstructured scintillator with optically isolated structures is used. In this case the optical crosstalk between neighboring pixels is prevented, which is suitable for mammography, dental imaging, and micro-CT (computed tomography).

By using a new architecture based on the ZnO nanostructures in a suitable membrane, proposed by our group, a better spatial resolution in comparison to traditional imagers can be achieved. In the proposed imager, each nanowire inside the membrane acts as a light guide (optical fiber) that prevents the generated optical photons to spread inside the imager. If this nano scintillator is coupled to a photocathode and the generated electrons enter to nano channels of an Anodic Aluminum Oxide (AAO) for electron multiplication, a new generation of extremely high spatial resolution position sensitive detectors can be achieved.

One of the advantages of ZnO nanowire scintillator is the simplicity of synthesized by template-assisted one-step electrodeposition technique. The results for ordered ZnO nanowire arrays in porous AAO template show that for 10 keV X-ray photons, by suitable selection of detector thickness and pore diameter, the spatial resolution less than one micrometer and detection efficiency of 66% are accessible.

The better spatial resolution of this nano scintillator in comparison to bulk and microstructured ones and the possibility of optimization the detection efficiency by increasing the porosity of the membrane and also its thickness at higher energies, are the advantages which candidate this nano scintillator for medical imaging or even particle tracking in the future.

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Session Classification: Poster session