



Contribution ID: 36

Type: **not specified**

Novel ideas for fabrication of hard X-ray imagers by combination of nano photo converter or nano scintillator with GEM detector

Monday 1 July 2013 16:45 (1h 10m)

One of the most marvelous applications of GEM is hard X-ray imaging. We suggested a novel nanostructure photo converter combined with GEM detector to increase the efficiency of X-ray detection by increasing the surface to volume ratio. Since the energy is deposited in the volume of the photo converter but the electrons can only escape from the surface, so by increasing the surface to volume ratio, it is expected that the quantum efficiency of photon to electron conversion is also improved. Experimentally, by using the Anodic Aluminum Oxide (AAO) membrane with conformal deposition of a wide variety of metals and metal oxides, extraordinary control over the thickness of these nano structured photo-cathodes can be achieved. The Monte Carlo simulation results also show that by suitable optimizing the dimension of the nano photo converter, the efficiency of the converter and also the performance of the whole detector can be improved. This nano photo converter is fabricated and the experimental test is currently underway. The other proposed new architecture for hard X-ray imaging is a hybrid nano scintillator-gas detector based on the ZnO nanostructure, which can give a better contrast and spatial resolution in comparison with traditional imagers. In this imager, the different refractive indexes between the ZnO nanostructure and the membrane, acts as a light guide that prevents the generated optical photons to exit from the ZnO nanostructure, which improves the spatial resolution of the imager. By suitable selecting the length of the ZnO nanostructure for the X-ray energy range and the type of position sensitive sensor for the scintillation light, the efficiency of the imager can also be improved. The proposed nano membranes are the AAO or the polycarbonate track-etched membrane, which deposition of scintillator material in these nano membranes is possible by simple and cheap electro deposition method. The GEM with Cesium Iodide coating is also a suitable position sensitive detector to detect the UV generated in ZnO nano scintillator in this hybrid nano scintillator-gas detector. The X-ray imager based on ZnO nanowires is simulated, designed and fabricated and tested with a CMOS imaging sensor. The test of these imagers with GEM is underway.

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Session Classification: Monday (poster session)