Contribution ID: **53** Type: **Poster**

P21 - A compact gas ionisation direct-STIM detector for MeV ion microscopy

Friday, 11 July 2014 13:00 (1 hour)

Scanning Transmission Ion Microscopy is a powerful technique that yields structural information in sub-cellular whole cell imaging [1,2]. Usually, a Si p-i-n diode is normally used in direct-STIM measurements as a detector. However, this is sensitive to radiation damage because when used to image deep sub–μm areas the ion fluence is high even for moderate numbers of ions per pixel. This leads to a shift in charge carrier collection efficiency which appears as an apparent degradation in energy resolution [3,4]. Gas ionisation detectors are intrinsically insensitive to radiation damage. Therefore, a compact gas ionization direct-STIM detector [4] is based on the Geiger-Muller geometry without a Frisch-grid is being developed for use in a MeV ion microscope based on a standard Oxford triplet lens and scanning system. In this work, the critical issues in designing the detector are a large the entrance window area to accept a scanned beam and obscuring as small a solid angle as possible to facilitate installation of proton induced fluorescence detector [2] while maintaining a small capacitance (10.2 pF) to achieve low noise. Tests with isobutane against a calibrated capacitor show that a resolution of about <~20 keV fwhm could be achieved which allowed imaging of Ren cells on a Si3N4 support and an effective ionisation energy of 21 eV at pressures above 600 mbar and bias voltage >600 V. The resolution is most probably limited by the charge sensitive amplifier resolution which is estimated to be ~180 e- rms in the current configuration.

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Session Classification: Poster Session with Cheese and Wine