Contribution ID: **98** Type: **Talk**

Position sensitive radiation detectors for high temperature environments using single crystal diamond

Thursday, 7 September 2017 14:10 (20 minutes)

A number of harsh industrial environments require radiation detectors which can operate at temperatures in excess of 200 degrees Celsius and may, in addition, require significant tolerance of the sensor to ionising radiation. Two application areas of current importance are the monitoring of radiation near high-pressure steam pipes in nuclear reactors used for electricity generation, and deep-level oil and gas exploration. With its wide band-gap of 5.5 eV and proven resistance to high levels of ionising radiation, single crystal CVD diamond is becoming well known as a particle detector at normal ambient temperatures. Recently we have been studying the performance of such sensors at elevated temperatures up to 250 degrees Celsius and in this paper we present results from a segmented, 4-pixel, radiation sensor utilising a 4×4×0.5 mm^3 CVD single crystal diamond. We present leakage current, noise and the spectroscopic resolution for alpha particles in the few MeV energy range as a function of temperature. We also determine the efficiency and the cross-talk between pixels. We compare our results with data collected previously from smaller, 2×2×0.5 mm^3 CVD single crystal diamond sensors, which have no position sensitive capability.

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Session Classification: Poster session