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# Fabrication, Characterisation and Test of a 3D Diamond Detector for Ionising Radiation

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We report on the fabrication and test of the first prototype of a 3D diamond detector for applications in particle physics. Polycrystalline and single-crystal CVD diamond samples have been processed with a femto-second laser to create arrays of graphitic columns with a diameter of a few microns. This 3D geometry of read-out electrodes enhances the radiation hardness due to the reduced carrier drift path compared to conventional planar detector geometries. Such an approach had been successfully tested for silicon detectors where a significant improvement in radiation hardness has been obtained. By processing 3D electrodes, we studied the gain brought to the performances of CVD diamond detectors. The prototypes used conductive graphitic micro-channels, as fabricated within the diamond bulk using an femtosecond IR laser (800 nm). Electronic properties of the device were evaluated, including current-voltage, transient-current, and charge collection efficiency characteristics using a Sr-90 Source. Complete prototype single-crystal and polycrystalline 3D diamond detectors with multi-channel charge integrating read-out have been tested with minimum ionising radiation in particle beams (proton/pion beam at CERN). Finally IBIC measurements were used under heavy ions to probe the benefit of the approach and evaluate the gain in terms of radiation hardness. The obtained results prove the viability of 3D diamond detectors for particle physics for the first time.

## quote your primary experiment

Collaboration with RD42

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