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Charge collection efficiency of three-dimensional polycrystalline diamond detectors

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Three-dimensional (3D) diamond detectors fabricated on high quality single-crystal CVD (scCVD) material show remarkable properties as 100% charge collection efficiency at electric fields as low as 0.04 V/μm. However polycrystalline CVD diamond (pCVD) is much more easily available with lower cost and larger areas. Hence the implementation of the 3D detector concept with pCVD diamond is highly desirable. The short inter-electrode distance of 3D detectors should improve the intrinsically lower collection efficiency of polycrystalline material, thus allowing to exploit its relative lower degradation to high radiation fluences with respect to the scCVD one. In this work we report on the fabrication and test of 3D pCVD diamond detectors, with different inter-electrode distances, and we prove that their collection efficiency is equal or higher, depending on geometry, than that obtained with conventional planar detectors fabricated with the same material. Preliminary results are also presented on the irradiation and test of these detectors with 1MeV equivalent neutrons.

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