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Beam test results of the dependence of signal size on incident particle flux in diamond pixel and pad detectors

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ABSTRACT: We present results of beam tests of charged particle detectors based on single-crystal and poly-crystalline Chemical Vapor Deposition (CVD) diamond. We measured the signal pulse height dependence on the particle flux. The detectors were tested over a range of particle fluxes from 2 kHz/cm^2 to 20 MHz/cm^2. The pulse height of the sensors was measured with pad and pixel readout electronics. The pulse height of the non-irradiated single-crystal CVD diamond pad sensors was stable with respect to flux, while the pulse height of irradiated single-crystal CVD diamond pad sensors decreased with increasing particle flux. The pulse height of the non-irradiated single-crystal CVD diamond pixel detectors decreased slightly with increasing particle flux while the pulse height of the irradiated single-crystal CVD diamond pixel detectors decreased significantly with increasing particle flux. The observed sensitivity to flux is similar in both the diamond pad sensors constructed using diamonds from the Pixel Luminosity Telescope (PLT) irradiated during its pilot run in the Compact Muon Solenoid (CMS) detector and in neutron irradiated diamond pad sensors from the same manufacturer irradiated to the same fluence of neutrons. The pulse height for irradiated poly-crystalline CVD diamond pad sensors proved to be stable with respect to particle flux.

KEYWORDS: Particle tracking detectors; Solid state detectors; Diamond Detectors; Radiation-hard detectors

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