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Edge Transient-Current Technique Investigation of Single-crystalline CVD Diamond

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The development of future high-energy colliders, such as the Future Circular Collider (FCC), requires detectors, particularly tracking systems, capable of operating in extremely high radiation environments. To meet this challenge, new radiation-tolerant materials are crucial. Owning to its wide band gap (5.47 eV) and considerable displacement energy (42 eV/atom), diamond is a promising candidate for the next-generation tracking detectors under such demanding conditions.

To gain a deeper insight into the charge transport properties of diamond, we have implemented the multi-photon absorption edge transient-current technique (MPA edge-TCT). Using an 800 nm femto-second laser, electron-hole pairs are generated at specific locations within the diamond bulk. And then after amplification and digitization, the induced transient current allows the detailed characterization of charge collection, electric field distribution, and carrier mobility. To further explore the influence of defects on charge transport, LED illumination and temperature-dependent studies are carried out on both irradiated and non-irradiated single-crystalline CVD (sCVD) diamonds. LED measurements employing a range of wavelengths (from red to UV) probe the behavior of defect-related depletion regions under optical stimulation, while temperature-dependent measurements up to 200 ℃ examine how the depletion region and charge transport evolve with temperature.

The results of this study will enhance the understanding of charge transport and defect-induced effects in diamond, thereby contributing to the optimization of radiation-hard diamond sensors for the FCC and other future high-luminosity experiments.

Type of presentation (in-person/online)

in-person presentation

Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

Author: XIE, Chen (ETH Zurich (CH))

Presenter: XIE, Chen (ETH Zurich (CH))

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