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W2 Effect of high energy proton irradiation on the optical properties of silicon carbide

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We report the effects, on the optical properties (photoluminescence and Raman scattering spectra), of high energy (70MeV) proton irradiation of bulk silicon carbide (SiC), at different doses. SiC has risen to prominence in the semiconductor industry for applications in high power and high-speed switching applications, especially in the field of electric vehicles and solar energy inverter systems. Its radiation hardness also lends it well to applications requiring measurement of high energy particles, e.g., for gamma- and neutron-detectors. More recently there has been a growing interest in the optical properties of SiC, especially as a platform for nonlinear and quantum photonics applications. Its relatively large bandgap (2.5 - 3.2eV) and strong nonlinear index (10^-18 m^2/W), both dependent on exact polytype, enable broadband supercontinuum and optical frequency comb (OFC) generation, especially when the material has been patterned into miniature optical waveguides. Efforts to perfect the growth and deposition of SiC-on-insulator (SICOI), combined with chemical etch and lithographic processing permits such waveguide-based photonic integrated circuits (PICs) in the same way as for silicon, making it an eminently scalable, and thus potentially inexpensive platform for next generation photonics device applications. Furthermore, just as for the so-called colour centers, based on e.g., nitrogen vacancies (NV-centres) in diamond, SiV-centers in SiC exhibit the similar optical character of single photon emission, and very recently spontaneous four wave mixing (sFWM) was used to demonstrate generation of entangled photon pairs and heralded single photons, leading to the potential for CMOS compatible, on-chip quantum photonics applications. Our work, using high energy, high flux proton irradiation, lays the foundations for delivering a flat, controlled concentration of SiV defects throughout the top layers of SiC as possible single photon sources that may be coupled to PIC components for enhanced quantum photonics applications.

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