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Yield Improvement of SiV^- Color Centers in Diamond via Silicon/Carbon Sequential Implantation

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Color centers in single crystal diamond are promising candidate sources of single photons for optical and electro-optical quantum computing platforms, as well as sensitive probes of local magnetic field. One such defect, the silicon-vacancy center denoted as SiV^-, is composed of a substitutional silicon atom paired with two carbon vacancies, and is of particular interest due to its relative insensitivity to environmental perturbations. Conventional methods for creating these color centers are non-deterministic in location and have low yield. Here, we describe an ion beam implantation technique in which Si and C ions are implanted sequentially into diamond substrates with micron-scale precision using Sandia's Tandem accelerator. Carbon is employed to increase the number of available lattice vacancies and thereby enhance the yield of color center formation. Preliminary photoluminescence results indicate that sequential implantation enhanced the SiV^- yield by ~140%. We discuss future work to increase yield by improved post-implantation annealing processes, as well as improved spatial positioning to tens of nanometers *via* focused ion beam implantation.