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IS668 EC-SLI: First results on lattice location of implanted 27Mg, 45Ca and 89Sr in diamond

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Among the many point defect colour centers in diamond, which are currently being intensively investigated for their applications in processing of quantum information, a Mg-related center has recently attracted special attention [1-3]. It is assumed that the center consists of a single Mg atom with one vacancy attached to it (MgV), which can also be pictured as a Mg atom occupying a bond-center site within a double vacancy, the so-called split-vacancy configuration [2-3]. This Mg colour center is a very efficient single photon emitter (theoretically predicted Debye-Waller factor of the zero phonon line 0.54 [3], compared to 0.03-0.04 for NV-, and 0.60 for SnV) for which also rather high creation yields up to 50% were reported following ion implantation [2].

The present study serves to probe possible configurations of implanted Mg in the diamond lattice, and to quantify the site occupancy as a function of implantation temperature. For that purpose, we have used the on-line beta– emission channeling method from short-lived 27Mg (t1/2=9.5 min) implanted at low fluences into CVD-grown diamond single crystals. Here we report on preliminary results obtained during our July 2021 beam time.

The 27Mg studies are supplemented by ongoing off-line lattice location experiments with the long-lived radioactive group-II probes 45Ca (164 d) and 89Sr (50.5 d). This should allow for a more systematic study, where lattice site preference of several implanted group II impurities can be probed, looking also for correlations with the ionic size of the impurity (0.72 Å for Mg2+, 1.00 Å for Ca2+, 1.18 Å for Sr2+).

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