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Ferromagnetism in Silicon Single Crystals with Positively Charged Vacancy Clusters[1] YU LIU, Helmholtz Zentrum Dresden-Rossendorf , XINGHONG ZHANG, QUAN YUAN, JIECAI HAN, Harbin Institute of Technology, SHENGQIANG ZHOU, Helmholtz Zentrum Dresden-Rossendorf, BO SONG, Harbin Institute of Technology — Defect-induced ferromagnetism provides an alternative for organic and semiconductor spintronics. Here, we investigated the magnetism in Silicon after neutron irradiation and try to correlate the observed magnetism to particular defects in Si. Commercially available p-type Si single crystal wafer is cut into pieces for performing neutron irradiations. The magnetic impurities are ruled out as they can not be detected by secondary ion mass spectroscopy. With positron annihilation lifetime spectroscopy, the positron trapping center corresponding to lifetime 375 ps is assigned to a kind of stable vacancy clusters of hexagonal rings (V6) and its concentration is enhanced by increasing neutron doses. After irradiation, the samples still show strong diamagnetism. The weak ferromagnetic signal in Si after irradiation enhances and then weakens with increasing irradiation doses. The saturation magnetization at room temperature is almost the same as that at 5 K. The X-ray magnetic circular dichroism further provides the direct evidence that Silicon is the origin of this ferromagnetism. Using first-principles calculations, it is found that positively charged V6 brings the spin polarization and the defects have coupling with each other.

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