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Lattice location of implanted 56Mn in 3C-SiC

SiC is a wide band gap semiconductor with an increasing number of applications in high-temperature electronics. Similar to Si, transition metals (TMs) in SiC are the source of deep levels in the band gap, however, the knowledge on structural properties of TMs in SiC, such as possible lattice sites, is much less advanced.
In this work we report first results on the lattice site location of implanted 56Mn (2.58 h) in single-crystalline cubic (3C)-SiC, evaluated by means of the emission channelling effect. Following 40 keV low-fluence (10ˆ13 cmˆ-2) ion implantation, the ⌧⌧ emission patterns from 56Mn implanted samples were measured with a position-sensitive electron detector around the <100>, <111>, <110> and <211> crystallographic directions. All measurements were performed at room temperature, starting with the as-implanted state and following 10 minute isochronal annealing steps up to 900 ºC in vacuum. While the data analysis is still in progress, so far we clearly identify Mn atoms located on three different lattice sites. In the as-implanted state, a fraction of 56Mn sits on tetrahedral interstitial sites with C atoms as nearest neighbours (TC). The second fraction is located near substitutional Si sites (SSi), roughly 0.05-0.20 Å away from the ideal SSi and ideal split<100> SPSi sites. The third fraction of Mn identified is sitting at bond-center C-Si (BC) sites.
Upon annealing up to 400℃ the Mn atoms sitting at BC sites move towards SC sites, whereas the Mn atoms located at TC interstitial positions do not move away.
At 500℃ annealing a decrease in the number of Mn at interstitial sites became obvious, however, this is not accompanied by the corresponding increase in the amount of Mn on substitutional sites. At annealing temperatures of 700ºC and above a decrease in the number of Mn at substitutional sites is observed. Although the analysis of the experimental data is on-going, it is already clear that no more than three sites play a relevant role in this system.

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