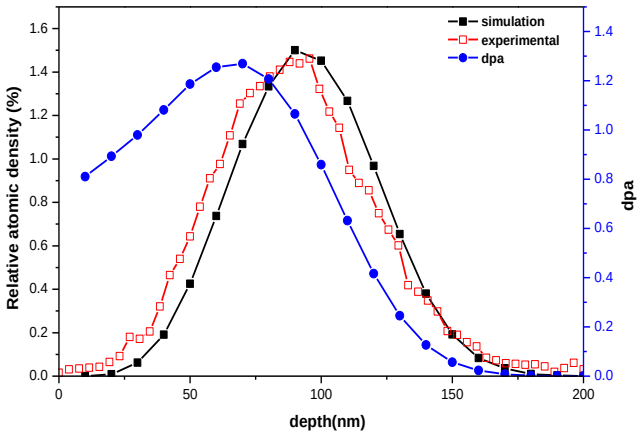

Figure 1. The RBS depth profile of Se implanted into SiC, TRIM2012 simulation and damage profile.

To investigate the migration behaviour of Se in polycrystalline SiC, the implanted samples were subjected to sequential isochronal annealing at temperatures ranging from 1000 to 1500°C in steps of 100°C for 10 hours. The Se depth profiles obtained from RBS before and after annealing are shown in Fig. 2. Neither a change in implanted Se profile nor broadening was observed after annealing at temperatures from 1000 up to 1200°C. These indicated the lack of detectable diffusion after annealing at these temperatures. The RBS profiles for the 1300°C samples indicated a small broadening of the profile and shift of the peak position of the Se profile. However, both were within the experimental error of the depth scale of our RBS measurements. For the 1400°C and 1500°C annealed samples there were measurable (only just for the 1400°C sample) broadening of the profiles and shift of the peak positions towards the surface (see Fig. 3(a) for the latter). Broadening of the profile is an indication of Fickian diffusion of the Se [11]. What was also noticeable was a general decrease in the heights of the profiles. To quantify this, the total integrated counts of the RBS Se signal (counts) were taken. The results are shown in Fig. 3(b). There was also a very slight asymmetry near the surface (i.e. x = 0) in the Se profiles at these two temperatures. This is due to evaporation into the vacuum of the Se atoms which diffused to the surface. The boiling point of Se is 685°C is significantly less than the annealing temperatures.

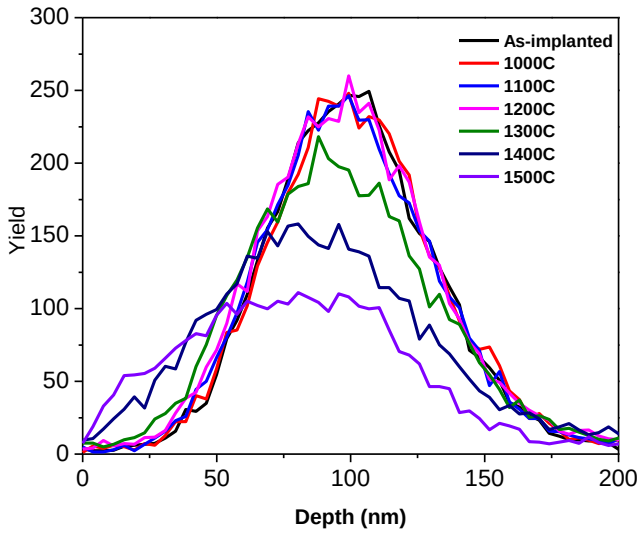

Figure 2. Depth profiles of selenium implanted in 3C–SiC at room temperature and after sequential isochronal annealing from 1000 to 1500 °C for 10 hours.

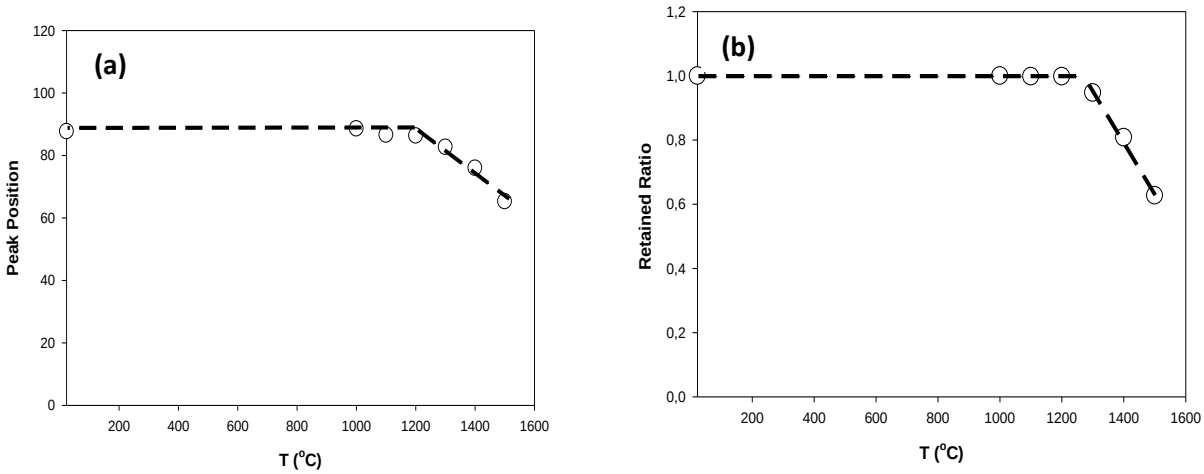

Figure 3. (a) The peak shift (b) retained ratio (calculated as the ratio of the total integrated counts of Se after annealing to that of as-implanted) of the Se profile as a function of annealing temperature.

To extract the diffusion coefficient of Se in polycrystalline SiC, the Se depth profiles obtained from RBS were fitted to the solution of the Fick diffusion equation for Gaussian as-implanted profile and with a perfect sink at the surface (see Fig. 4) [11]. The diffusion coefficients of $(8.0 \pm 0.24) \times 10^{-21}$ and $(1.1 \pm 0.33) \times 10^{-20}$ m^2s^{-1} were extracted at 1400 and 1500°C, respectively. No previous Se

diffusion in SiC data were obtained in literature hence the obtained diffusion coefficients were not compared with any literature values.

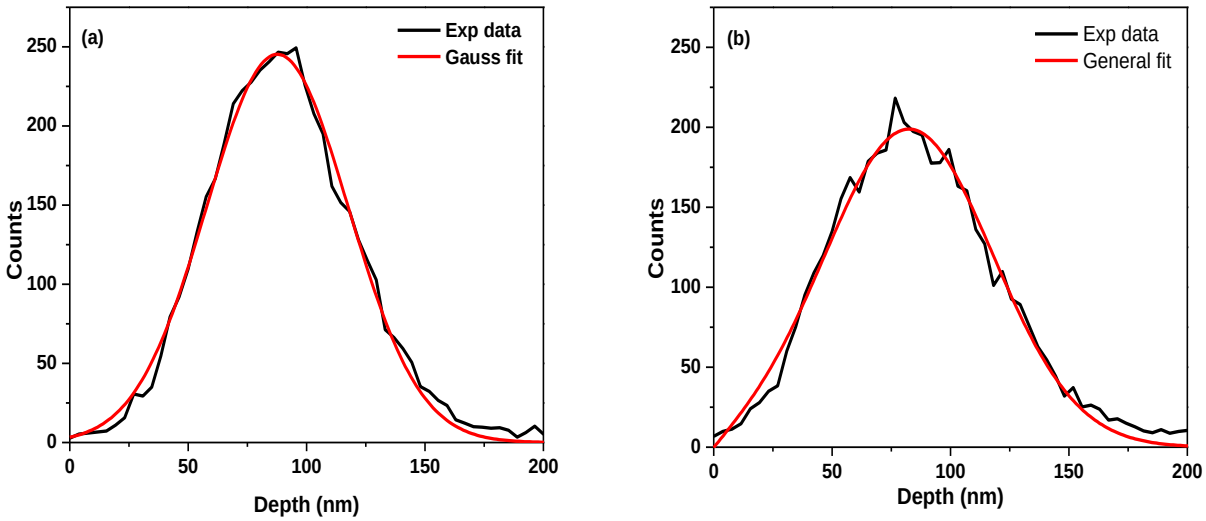

Figure 4. Example of the fitting of the diffusion equation solution to the depth profiles of the sample (a) as-implanted (Gaussian fit only) , (b) annealed at 1300°C

4. Conclusion

In this work, the migration behaviour of Se in polycrystalline SiC has been studied in terms of diffusion. Se^{+} of 200 keV was implanted at RT to a fluence of 1×10^{16} cm^{-2}. The implanted sample was isochronally annealed at temperatures ranging from 1000 to 1500°C in steps of 100°C for 10 h. The effect of annealing on Se implanted on SiC and its migration behaviour was investigated using RBS.
No diffusion was observed after annealing at temperatures from 1000 up to 1300°C. The diffusion of Se began after annealing at 1400°C and increased with temperature. Also, the Se peak profile began shifting towards the surface after annealing at 1400°C and became more pronounced at 1500°C. This shift was accompanied by loss of Se from the surface. Significant loss, viz. about 40%, was observed at 1500°C. From fitting of the Se profile in the annealed samples, diffusion coefficients were extracted for the samples annealed at 1400°C and 1500°C.

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