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Mössbauer study of 57Fe in GaAs and GaP following 57Mn+ implantation

GaAs, GaP, Mössbauer Spectroscopy, 57Mn+ implantation, Fe impurity defects

Summary

Ion implantation provides a precise method of incorporating dopant atoms in semiconductors, provided lattice damage due to the implantation process can be annealed. We have undertaken 57Fe Mössbauer spectroscopy measurements on GaAs and GaP single crystal samples implanted with radioactive 57Mn+ ions (T½ = 1.5 min) at the ISOLDE facility, CERN. The samples were held at temperatures between 77 –700 K in an implantation chamber and implanted with fluences up to 1012 ion/cm2. Mössbauer spectra were recorded with a resonance detector equipped with stainless steel electrodes enriched in 57Fe and mounted on a conventional velocity drive system outside the chamber. The fitting of the measured Mössbauer spectra required four components (Fig. 1): (i) an asymmetric doublet (D1) attributed to Fe atoms in distorted environments due to implantation damage, two single lines: (ii) S1 assigned to Fe on substitutional Ga sites, (iii) the other (S2) to Fe in interstitial sites, and (iv) a low intensity symmetric doublet (D2) assigned to impurity-vacancy complexes.
At temperatures above 400 K, the extracted hyperfine parameters of the damage site for both materials show pronounced variation, evidencing changes in the immediate environment of the Mössbauer probe nucleus and also possibly to the Fe-defect bonding mechanism. Fig. 2 shows the variation in site fractions with temperature. The annealing of the radiation damage is more pronounced in GaAs as compared to GaP and more will be discussed in detail during the presentation.

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Yes

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Oral or Poster

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