Implant Isolation in N-Type InP Implanted with Low and High Energy He+ and B+

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Ion irradiation is used to produce high resistivity regions in both n- and p-type InP that can be used for device isolation and current guiding. In the work reported here an extensive study has been carried out to investigate the changes in the electrical properties of n-type InP, doped in the range $2.5 \times 10^{16} - 4.4 \times 10^{18} \text{cm}^{-3}$, and bombarded with 55 keV He+ and 125 keV B+. In addition we have explored the use of MeV He+ bombardment to produce deep regions of high resistivity. For the keV bombardments the resistivity initially increases with ion dose and reaches a maximum at $\sim 5 \times 10^{13} \text{cm}^{-2}$ independent of the ion species and initial carrier concentration. However, at the lowest doses, $< 10^{13} \text{cm}^{-2}$, the carrier removal rate is directly dependent on the carrier concentration. These results will be discussed in terms of the production of various defects and defect/dopant interactions. For doses $> 10^{14} \text{cm}^{-2}$ all samples exhibit identical resistivity values consistent with the onset of hopping conduction. For the MeV bombardments the damage profile can be split into two regions, (i) near the surface a fairly uniform defect density with depth is produced and (ii) a deep peak with a higher defect density by a factor of $\sim 5$. The resistivity vs dose behaviour is similar to that for the keV ions and we show that it is possible to separate the resistance contributions from the two regions by their relative defect densities obtained using TRIM.