

Concentration profiles of vacancy defects from MeV implants in Si: Dependence on Ion species and Dose

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Monte Carlo simulation codes such as TRIM or MARLOWE show a net displacement of interstitials with respect to vacancies from the Frenkel pairs produced in implant cascades. This effect is most evident for high-energy and/or large mass implants. As a result of this displacement, calculated damage profiles show an excess of vacancies in the shallow region of these implants, with excess interstitials near R_p . In this work, the "Au profiling" technique has been used to quantitatively analyze and compare the depth profiles of excess vacancies produced by implants of B, Si, and Ge into Si for a range of doses. Specific conditions, like matching of the projected range of the implanted ions, matching of the nuclear energy deposited at $1/2R_p$, similar doses, etc. have been compared. This detailed study provides the first systematic, quantitative measurements of the excess vacancy concentrations over such a range of species and doses. Interestingly, some general characteristics of the excess vacancy profiles differ from simulations. For example, while the calculations predict essentially flat profiles up to the surface, the experimental observations differ in that there is a depletion of the vacancy concentration near the surface. We will discuss the origins of this and other aspects of the measured vacancy profiles.

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