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FORMATION AND ELIMINATION OF RADIATION DEFECTS RESPONSIBLE FOR CHARGE CARRIER REMOVAL IN BORON DOPED SILICON

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When irradiated with fast particles, the radiation damage associated with the removal of charge carriers in n-type silicon (n-Si) is mainly due to the formation of vacancy-type defects (divacancy, A and E centers). In p-Si, an important role in the removal of charge carriers is related with interstitial defects. The appearance of silicon interstitial atoms induced by irradiation initiates a series of branching reactions. As a result of these branching reactions, interstitial impurity atoms appear in the crystal and their subsequent migration and trapping results in formation of defect complexes which are stable at room temperatures.
The aim of this work is to analyze factors which influence on the behavior of interstitial-type defects in irradiated silicon doped with boron. The analysis is based on our experimental data obtained after irradiation with electrons (E=5.5 MeV) or alpha-particles (E=5.15 meV).
It has been shown that the distribution of primary self-interstitials between impurity traps depends not only on impurity concentrations but also on the dose rate and type of bombarding particles.
The irradiation induced boron-oxygen complex in Si diodes can be annealed at room temperature by applying forward current injection. This injection helps to restore the initial concentration of substitutional boron. However, the hole concentration is restored only partially due to the additional formation of interstitial carbon-interstitial oxygen complexes.
At temperatures of about 370 K a new compensating defect is formed after annealing of the interstitial oxygen-silicon di-interstitial complex. It appears in DLTS spectra as ME1 center or double peak BH1/BH2. The comparison of its formation in diodes made from epitaxial and Czochralski-grown silicon lead to the conclusion that the ME1 center is related to a boron containing complex.
The possibilities to mitigate radiation damage of diode structures made of boron-doped silicon are also discussed.

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