

Abstract

The electrical properties of diodes fabricated on undoped and zinc-doped n-silicon were investigated in this study using current-voltage (I-V) and capacitance-voltage-frequency (C-V-f) techniques. The diode's forward current decreased by a factor of ~ 3 , while the reverse current increased by a factor of ~ 37 , confirming that the charge carrier recombination/compensation is due to the generation of minority carrier to increase the resistivity of the material upon doping with zinc (Zn). The generation of the minority carrier was confirmed by inversion of the material conductivity from n- to p-type, as shown by C-V results. Furthermore, the findings reveal that Zn is responsible for a reduction in full depletion voltage (FDV), implying that the space charge region (SCR) width can be fully depleted with a relatively low applied voltage. For the manufacturing of sensitive radiation detectors, a low FDV is critical. A change in the electrical properties of the diode was explained in terms of defects induced in the Si bulk by Zn. The properties of Zn-doped n-Si-based diodes are similar to those of radiation-hard Si devices. In general, the findings suggest that Zn might be employed as a possible dopant in a study to improve the characteristics of Si to fabricate radiation-hard and sensitive detectors for current and future high energy physics experiments.