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Boron-doped silicon: a possible way of testing and refining models of non-ionizing energy loss under electron- and proton irradiation

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Received: September 3, 2022
Revised: September 3, 2022
Accepted: September 5, 2022

In this paper formation and annealing of boron-related defects in p-type silicon grown by the floating zone technique and subjected to electron and proton irradiation at room temperature are discussed. The defect model suggested earlier has provided fresh insight into the nature of two dominant complexes containing boron in irradiated p-Si, among them boron-divacancy complexes and interstitial boron-substitutional boron pairs. In the present work the same material is irradiated with 6 MeV electron and 8 MeV protons providing additional electrical data to test this model. Additionally new information on boron-related defects in heavily doped p-Si subjected to irradiation with 2.5 MeV electrons at 4.2 K and then subjected to isochronal anneals above room temperature is also discussed. The results obtained on proton irradiated p-Si(FZ) testify that the annealing behavior of boron-divacancy complexes appears to be complicated, in contrast to the behavior of interstitial boron-substitutional boron pairs. The defect model based on the experimental information furnished so far may be used for testing and refining computerized simulations of non-ionizing energy loss in irradiated silicon.

Keywords: silicon, boron impurity, electron- and proton-irradiation, impurity-related complexes.