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Electrically active induced energy levels and metastability of B and N vacancy-complexes in 4H-SiC

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Electrically active induced energy levels in semiconductor devices could be beneficial to the discovery of an enhanced p or n-type semiconductor. N implanted into 4H-SiC is a high energy process that produced high defect concentrations which could be removed during dopant activation annealing. On the other hand, B substituted for silicon in SiC leads to a decrease in the dielectric properties and induced deep donor and shallow acceptor levels. Complexes formed by the N, such as the nitrogen-vacancy centre, have been reported to play a significant role in the application of quantum bits. The results of charge states thermodynamic transition level of the N and B vacancy-complexes in 4H-SiC are presented. The energies of formation of the N related vacancy-complexes shown the N_CV_C to be energetically stable close to the valence band maximum in its double positive charge state. The N_CV_{Si} is more energetically stable in the double negative charge state close to the conduction band minimum. The N_{Si} V_C on the other hand, induced double donor level and the N_CV_{Si} induced a double acceptor level. For B related complexes, the B_CV_C and B_{Si}V_C were energetically stable in their single positive charge state closed to the valence band maximum. As the Fermi energy is varied across the band gap, the neutral and single negative charge states of the B_{Si}V_C become more stable at different energy levels. B and N related complexes exhibited charge state controlled metastability behaviour.

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