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Neutralization of Boron in Si by Hot Ar^+ Ion Bombardment

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Gettering of group III and V impurity atoms in Si is hard to realize because of their low diffusivities at T<900 °C, whereas at T>900 °C the probability for the impurity atom to be captured is low and even the gettering centers may be destroyed. Commonly used passivation with H is stable only up to 400-500 °C, that is far below the temperatures employed in silicon device technology. This report demonstrates the possibility of gettering and neutralization of B in Si in a single step by hot Ar^+ bombardment. Boron doped Si, $\rho \sim 10^{19}$ cm^{-3} was irradiated with 135 keV Ar^+ ions at T=900 °C within the dose range of 10^{15}-10^{17} cm^{-2}. The aim was twofold - to produce stable defects near R_d as the gettering centers and to enable migration of boron atoms toward these centers by virtue of radiation enhanced diffusion. Incremental Hall effect measurements, SIMS and C-V profiling were used for the investigations. Up-hill diffusion of boron toward the surface ($R_d \sim 0.1$ μm) was observed with neutralization of boron acceptors. For the 0.2-0.3 μm thick near-surface layers with boron concentration of ~5 x 10^{19} cm^{-3} hole concentration was found to be less than 5 x 10^{15} cm^{-3}. The gettering and neutralization effects were resistive against subsequent annealing up to 1100 °C.