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Charge Trapping in Thermal Silicon Dioxide*

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An overview of charge trapping studies in the silicon dioxide layer of metal-oxide-silicon (MOS) structures is presented. Negative charge trapping associated with sites in the silicon dioxide bandgap related to implanted Al is discussed in detail as an example. The negative trapped charge location is shown to be identical to the implanted Al location by use of the photocurrent-voltage (photo I-V) technique and secondary ion mass spectroscopy (SIMS). Electron trapping and detrapping rates are studied using capacitance voltage (C-V) and photo I-V techniques to deduce capture and ionization cross sections for these sites. The centroid and the capture cross sections are studied as a function of oxide thickness, ion fluence, post-implantation annealing conditions, and ion implantation energy. The number of traps is shown to be proportional to ion fluence and implantation energy. Implanted Al is shown to penetrate up to 100 Å deeper than predicted by the theory of Lindhard, Scharff, and Schiott (LSS). Comparisons between several implanted ions (Al, As, P, B) in SiO_2 are made with respect to the quantities of interest (centroid location, capture cross section, photoionization cross section, etc.) for negative charge trapping on sites related to the implanted ions.

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