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Charge-diminution at the Si-SiO₂ system interface

D Kropman¹, T Laas¹, V Seeman², A Medvids³ and P Onufrievs³¹Tallinn University, Estonia²University Tartu, Estonia³Riga Technical University, Riga

The fact that a positive charge formation occurs in SiO₂ film during the process of Si thermal oxidation is already known, with the formation being dependent upon the oxidation conditions which involve temperature, time and ambient conditions. This is connected by oxygen vacancies in the SiO₂ film and unsaturated Si³⁺-bonds at the interface. Until now, this process has not been studied in depth at an atomic level. The purpose of the present work is to investigate the charge formation in the Si-SiO₂ system and its diminution by means of the appropriate choice of oxidation conditions via EPR spectroscopy, IR spectroscopy, CV curves, TEM, and deflection measurements. Laser irradiation and ultrasonic treatment were used for the modification of interface properties. It has been established that, at an oxidation temperature that is within the range of 1125°C-1130°C in SiO₂ film with a thickness of 0.2-0.3μm at the interface, there appears a low positive or negative charge which is connected with negatively charged acceptors that are formed by Si vacancies, and the positive charge in the SiO₂ is compensated. The results that were obtained coincide with the point defects generation kinetic model in the Si-SiO₂ system which was proposed in and was confirmed experimentally. Integral circuit technology conditions that allow the interface charge to diminish were introduced by the semiconductor plant, ALFA (Riga, Latvia). We supposed that these results, which were obtained during long term collaboration between Estonia and Latvia, constituted a discovery that had been achieved by Si-SiO₂ system investigation no less than thirty years ago: the discovery of the quantum Hall effect on the Si-SiO₂ structure.

daniel.kropman@mail.ee