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# Magnetic Field Induced Prolonged Changes of Electric Parameters of MOS Structures

Vladimir M. Maslovsky, Jury O. Lichmanov Nickolai S. Samsonov and Elena V. Simanovich, Zelenograd Research Institute of Physical Problems, Zelenograd, Moscow 103460, RUSSIA. FAX : (095) 531-4656.

In this work for the first time there were obtained pulsed magnetic field induced prolonged changes (MFIPC) of charge stability (CS) histograms and I-V characteristic of silicon MOS structures. These changes indicate the MFIPC of surface density D of detected microdefects near interface. It was discovered that D increased non-monotonously after pulsed magnetic field treatment (PMFT). Such prolonged changes of MOS structure electric parameters are closely connected with the diffusion instability arising in silicon subsurface region and that may be induced by PMFT [1,2].

The test MOS structures (formed by thermal oxidation of silicon wafer) were under the influence of some PMFT pulses with amplitude of H= 0.1-03 MA/m, 0.02-0.05 ms duration and pulse frequency 10 Hz. It was detected that there were no appreciable variations of the parameters just after short-term treatment (less than 10 s).

The MFIPC of spectrum of interface states were registered by DLTS method. The density of the surface states with the energy $E_c$ = 0.22 eV (divacancy) vary by 30 percent. This is confirm the result of [1] about the role of vacancies in the MFIPC phenomenon.

At room temperature the variations of CS (Fig. 1.) and leakage voltage ($V_l$) (measured at constant current through dielectric) (Fig. 2.) are observed for a week after the end of short- term effect. It is important to note that the MFIPC of $V_l$ were accompanied by the internal mechanical stresses (IMS) changes in Si-$SiO_2$ systems. The Raman scattering spectra were registered during some days after PMFT. The IMS values in sub-surface regions were evaluated by the frequency shift of 520 $cm^{-1}$ phonon line. The IMS increased monotonously during 6 days after PMFT and attained 60 MPa. Relaxation of those stresses resulting in microcrack generation in dielectric was in agreement with the IMS relaxation in Si-$SiO_2$ systems. Before PMFT the I-V characteristics for all structures corresponds the curve 1 in Fig. 3 ( the results of multiple testing of every structures leakage current at I < 100 nA range). After approximately 5 days of PMFT almost 10 percent of MOS-structures were characterized by I(E) shown in Fig. 3 on the left-side of the curve 3. Such I(E) characteristics where similar to those of initially defective MOS-structure and was depicted by power dependence of current verses voltage in contrast to the known Fowler-Nordheim dependence for defect-free MOS-structure. Such conductivity is due to electron transfer via localized states at microcrack surfaces formed by high density broken bonds ($N_t \approx 10^{14} cm^{-2}$ ) in dioxide [3]. Such MFIPC of MOS structure electric parameters are closely connected with the diffusion instability arising in silicon subsurface region.

1. M.N. Levin, V.M. Maslovsky. MRS Symp. Proc. Ser. V 319, Defect-Interface Interactions (1994).
2. M.N. Levin, V.M. Maslovsky. Solid State Communications. V. 90. N 12, 813-815 (1994).
3. Lichmanov, V.M. Maslovsky. Thin Solid Films. V 257. P 134-136 (1995).

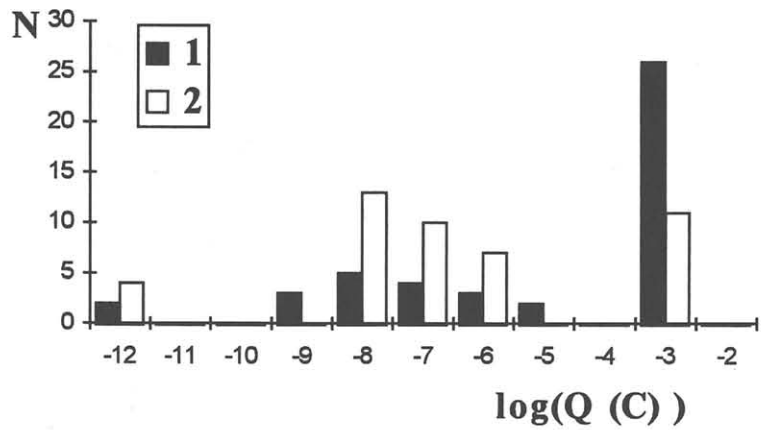


Fig 1.CS histogram: 1, initial; 2, 140 h after the end of PMF treatment.

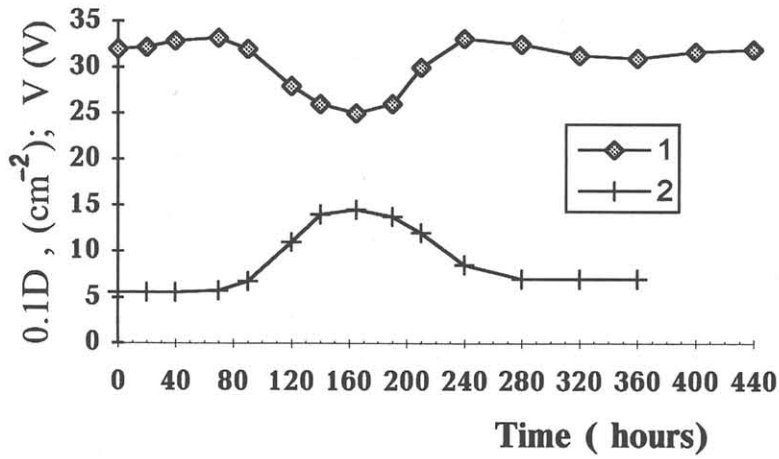


Fig 2. Temporal dependencies of MOS-structures parameters changes after the end of PMF treatment: 1, $V_1$ ; 2, microdefects density near $Si\text{-}SiO_2$ interface.

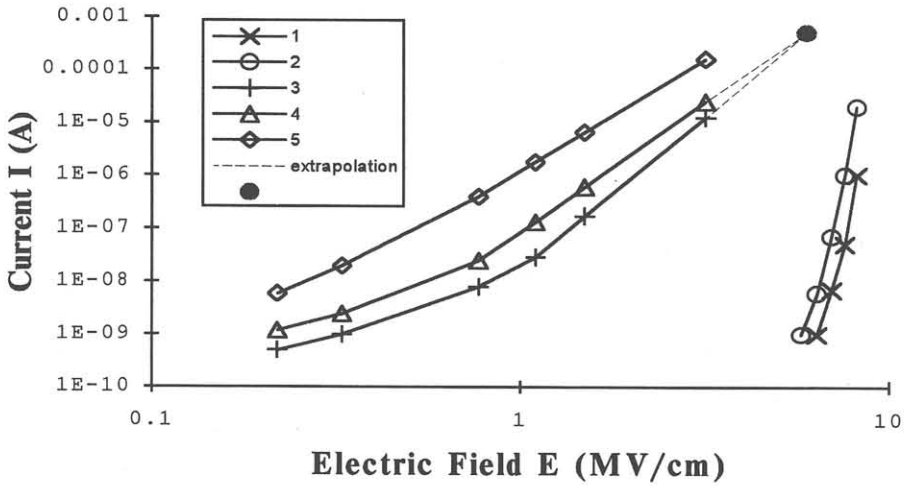


Fig. 3. Dielectric leakage current vs. electric field for MOS structures: curves: 1, before; 2 and 3, in 3 and 6 days after PMFT respectively; 4, the same of 3, but heated to 375 K; 5, for initially defective MOS structures.