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**DETERMINATION OF ELECTRON BEAM CHARGING CONDITIONS OF OXIDES AT LOW ENERGY
IN THE LOW DOSE RANGE**

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Scanning Electron Microscope (SEM) voltage contrast techniques proved to constitute a valuable tool for testing integrated circuits (IC). However, the active components may be damaged by electron beam irradiation, so that it is of great importance to determine accurately the allowable limits.

Different types of effects arise and starting from high to low primary energies, two zones may be distinguished. In the case of classical MOS transistors, if the primary electron (PE) penetrate down the gate oxide, strong charging effects result (1) but if the PE are located on the top oxide above the polysilicon gate only existing flaws inside the gate oxide are influenced by reemitted photons. So the sensitivity of the observed threshold voltages shifts are strongly dependent on the incident beam energy (1,2). In the case of the floating gate MOS transistors, due to the fact the deposited charges by the electrons on the top oxide are not electrostatically screened, an additional channel conductance modulation occurs.

The purpose of this paper is to show the achievement of e-beam charging evaluations on insulators using MOS floating gate transistors. This method is achievable in classical SEM without any additional surface preparation.

We present the different ways to obtain quantitative results using either a couple of classical and floating gate transistors either a controlled gate element. The equations governing the electrical characteristics of the floating gate MOS transistors are derived, they show good agreement with the experimental results. The deposited charges may be evaluated both in linear or saturation regions of the devices assuming a previous characterization of the technology used. The negative charging evaluation are obtained in the 2-6 keV range and our method allows the determination the following magnitudes 1.10^{-9} - 1.10^{-6} C.cm⁻². Basing on these results, it is shown that surface charge exchanges are necessary to fit experiments and theory in the range considered.

Finally, we have shown the possibility of e-beam charging evaluations on microelectronics insulators, using simple MOS devices, with good accuracy and sensitivity.

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