INVESTIGATION OF TRAPPING PROPERTIES IN SIMOX FILMS BY PHOTO-INDUCED TRANSIENT CURRENT SPECTROSCOPY

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It has recently been shown that the interface and volume trapping properties in thin SOI films can be evaluated using a number of current-based measurement techniques (charge pumping, noise, dynamic transconductance, DLTS). These measurements require MOS devices to be processed which involves, in turn, a modification of the natural character of the SOI structure. An elegant solution of studying the minority carrier trapping in *un-processed* SOI materials is offered by the Photo-induced Transient Current Spectroscopy (PTCS). The method consists of filling interface states and bulk traps via pulsed photo-excitation and then monitoring the transient current which corresponds to the carrier emission process.

For instance, in a n-type SOI film only the holes are trapped during illumination. As the electron-hole recombination is a very rapid process, when the light is switched off the instantaneous concentrations of excess electrons and trapped holes become equal. In other words, the emission rate of trapped holes is the same as the decay rate of the excess electron concentration which is proportional to the transient current.

The experiment was carried out in SIMOX material synthesized by deep oxygen implantation (1.8×10^{18} cm^{-2}, 200 keV, 550°C) and high temperature annealing (1340°C, argon). The illumination was provided by a LED array (940 nm wavelength, 25 mW). The sample was biased at 0.2 V and the current was monitored using a measuring system composed of a current to voltage converter and a lock-in amplifier.

The output voltage is related to the density of traps while the frequency gives their emission rate and energy position in the gap. A typical energy profile is shown in Fig. 1 and demonstrates a clear increase of the trap density near the valence band edge. The density of 10^{12} traps/cm^2 is a reasonable value as far as the proximity of the *buried interface* is concerned and should not significantly affect the performance of integrated circuits. This profile will be compared with those obtained in lower quality SIMOX or deduced from charge pumping in MOS devices.

PTCS experiments have been conducted in parallel with conventional static photoconductivity and photo-Hall effect (Fig. 2). Measurements at very low temperatures reveal good values for the carrier mobility and lifetime as well as normal scattering mechanisms and impurity ionization. However, a donor-like process-induced contamination was found to occur due to the oxygen activation or annealing conditions. The region situated near the buried interface is shown to be responsible for the transition to *hopping* conduction mechanism below 60 K. A two-band model allows us to explain the minimum observed in the carrier concentration curve (Fig. 2).