1018-Angle Resolved Differential IBIC analysis of silicon power diodes.

Michele Pezzarossa [1], Enrico Cepparrone [2], Milko Jaksic [3], Georgios Provatas [3], Donny Domagoj Cosic [3], Milan Vićentijević [3], *Ettore Vittone* [2]

Politecnico di Torino (Italy) Applied Science and Technology Dept. (DISAT) torino-Italy [1] Università di torino Physics torino-Italy [2] Ruder Boskovic Institute Laboratory for Ion Beam Interaction Zagreb-Croatia [3]

This contribution describes both an experimental methodology based on the Ion Beam Induced Charge (IBIC) technique and the relevant interpretative model, which were adopted to characterize the electronic features of semiconductor diodes.

The experiment was carried out at the Ruder Boskovic Institute of Zagreb (HR) within the UE-RADIATE project, using rarefied focused proton beams to induce charge signals on commercial p-i-n silicon diodes. A thousand of IBIC spectra were acquired by irradiating a region of about (0.1x0.1) mm2 of the diode frontal electrode under different experimental conditions, which include the energy of protons ranging from 1.2 to 2.0 MeV, the angle of incidence of the ion beam ranging from -50° to +50° with respect to the normal of the sample surface, and the applied reverse bias voltages.

The modulation of the ion probe range obtained both by using different proton energies and/or by tilting the sample, allowed the charge collection efficiency scale to be accurately calibrated, as well as the dead layer beneath the thick (6 micrometer) Al frontal electrode to be measured with a sub-micrometer resolution.

This calibration was essential to measure the carriers' lifetime through the analysis of IBIC spectra resulting from charge signals generated by different ionization profiles of the ion probes, combined with different extensions of the depletion layer, determined by the application of reverse bias voltages, to realize fully and partially depletion conditions.

The analysis was carried out adopting an analytical model extracted from the basic IBIC theory; although the many simplified assumptions adopted, the model proved to be suitable to interpret the behavior of the IBIC spectra as a function of all the experimental conditions (ion energy, tilting angle, applied bias voltage) and to provide a measurement of the carriers lifetime in the intrinsic region.