8th International Workshop on Semiconductor Pixel Detectors for Particles and Imaging.

Contribution ID: **78** Type: **contributed paper**

Application of a Transient-Current-Technique based on a Two-Photon-Absorption process to the characterization of a HV-CMOS deep n-well

Transient Current Techniques (TCT) based on laser-induced photo-currents produced by Single Photon Absorption (SPA) processes have been extensively used during the last two decades as a powerful tool to study many of the properties relevant to operation of semiconductor detectors such as the electric field distribution, carriers mobility, CCE, VDep, trapping lifetimes and the space-charge sign and geometry of complex segmented semiconductor junctions; moreover, the TCT techniques have been proven an excellent method for the understanding of the radiation-induced alterations of the semiconductor material and junction structure [1]

Very recently, an innovative Transient Current Technique was introduced where the free charge carriers are created in a Two-Photon-Absorption (TPA) process induced by a focused femto-second laser pulse with a wavelength of 1300nm[2][3]. The fact that in a TPA process the absorption of the light depends on the square of the intensity of the light beam used for the current generation allows a localized TPA-induced electron-hole pair creation in a micrometric scale voxel centered on the laser waist. As a consequence, this new technique opens the possibility to carry out a 3D mapping of the sensor's space-charge properties with micrometric resolution.

Due to its intrinsic spatial resolution, the TPA-TCT technique is a very appropriate choice for the characterization of the alterations of the sensor's active volume induced by the ionizing radiation; in especial manner, for the case of partially depleted sensors as it is the case of the carrier collecting n-well implemented in HV-CMOS sensors.Using the TPA-TCT technique on a HV-CMOS device the deep n-well has been accurately measured being able to to determine its effective doping concentration for the first time in this kind of depleted CMOS devices[4] achieving a unprecedented insight on the doping level and dimensions of the deep n-well suitable for a better understanding and optimization of the device design.

[1] G. Kramberger, Advanced Transient Current Technique Systems, PoS(Vertex2014)032

[2]F. Rogelio et al, Two Photon Absorption and carrier generation in semiconductors, presented at 25th RD50 Workshop, CERN, Geneve, 17-19.11.2014.

[3] I. Vila et al., "TPA-TCT: A novel Transient Current Technique based on the Two Photon Absorption (TPA) process", presented at 25th RD50 Workshop, CERN, Geneve, 17-19.11.2014.

[4] M. Fernández et al, High-resolution three-dimensional imaging of a depleted CMOS sensor using an edge Transient Current Technique based on the Two Photon Absorption process (TPA-eTCT) (NIM A accepted for publication).

Primary authors: Prof. PALOMO PINTO, Francisco Rogelio (Escuela Técnica Superior de Ingenieros Universidad de Sevilla); Dr VILA, Ivan (Instituto de Fisica de Cantabria (CSIC-UC)); Mr FERNANDEZ GARCIA, Marcos (IFCA-Santander); Dr MOLL, Michael (CERN); Dr MONTERO, Raul (EHU-UPV)

Presenter: Dr VILA, Ivan (Instituto de Fisica de Cantabria (CSIC-UC))