iWoRiD 2022
23rd International Workshop on Radiation Imaging Detectors
26 – 30 June 2022
Riva del Garda, Italy

Contribution ID: **7** Type: **Poster**

Characterisation of heavily irradiated dielectrics for AC-coupled pixel detectors

Wednesday 29 June 2022 17:21 (1 minute)

An increase in the radiation levels during high-luminosity operation of the LHC and future colliders calls for the development of silicon based pixel detectors used for particle tracking and vertex reconstruction. Capacitively coupled (AC-coupled) detectors are anticipated to be in operation in future collider experiments as they provide an enhanced isolation between pixel areas due to radiation-induced leakage currents. The motivation of this study is the development of next generation capacitively coupled (AC-coupled) pixel sensors with coupling insulators having a good dielectric strength and radiation hardness simultaneously. The AC-coupling insulator thin films were aluminum oxide and hafnium oxide grown by Atomic Layer Deposition (ALD) method.

Our work focuses on a comparison study based on the dielectric material used in MOS, MOSFET and AC-pixel sensors processed on high resistivity p-type Magnetic Czochralski silicon (MCz-Si) substrates. These prototypes were irradiated with 10 MeV protons upto a fluence of 5e15 protons/cm^2 as well as with Co-60 source upto 1 MGy. Capacitance-voltage measurements of MOS and MOSFET test structures indicate negative oxide charge accumulation induced by irradiation. These studies are coherent to numerical simulations. Furthermore, electrical characterization using current-voltage and edge-TCT methods indicate very good dielectric strength performance in both materials as well as show the impact of the dielectric-silicon interfaces on the functionality of the sensors, even after irradiation. The negative oxide charge during the irradiation is an essential pre-requisite of radiation hardness resiliency of $n^+/p^-/p^+$ (n on p) particle detectors widely intended to be used in future high-luminosity experiments.

Author: BHARTHUAR, Shudhashil (Helsinki Institute of Physics (FI))

Co-authors: GÄDDA, Akiko (Helsiki Institute of Physics); KARADZHINOVA-FERRER, Aneliya (Helsinki Institute of Physics (FI)); TUOMINEN, Eija (Helsinki Institute of Physics (FI)); OTT, Jennifer (University of California,Santa Cruz (US)); BRUCKEN, Jens Erik (Helsinki Institute of Physics (FI)); GOLOVLEVA, Maria; BEZAK, Mihaela (Rudjer Boskovic Institute (HR)); Mr KRAMARENKO, Nikita (Helsinki Institute of Physics); LUUKKA, Panja (Lappeenranta University of Technology (FI)); KIRSCHENMANN, Stefanie (Helsinki Institute of Physics (FI))

Presenter: BHARTHUAR, Shudhashil (Helsinki Institute of Physics (FI))

Session Classification: Poster