Contribution ID: **40** Type: **Oral**

Discharge quenching mechanism and RPWELL performance with tunable 3D printed resistive plates

Wednesday 8 November 2023 09:50 (25 minutes)

Resistive electrodes are used in gaseous detectors to quench spark discharges. This helps to protect delicate electrodes and readout electronics and to improve the stability of the detector operation. An RPWELL is a THGEM-based WELL detector with a resistive plate coupled to a conductive anode. Till now, the choice of the resistive plate was limited to a few materials, like LRS Glass and Semitron. These materials have fixed resistivities and, sometimes, pre-defined thickness and area limitations. These shortages restrict the potential usage of the detector to a rather small range of applications, as well as the possibility of studying in depth the physics processes governing the discharge quenching mechanism.
In our present study, we used a new plastic material doped with carbon nanotubes (3DXSTAT^{TM} ESD ABS) to produce resistive plates by Fused Deposition Modelling (FDM) technique pouring the material layer after layer with a commercial 3D printer. This method has the flexibility to produce samples of different thicknesses and different resistivity values. We will describe in detail the sample production, RPWELL performance with different resistive plates and show the dependence of discharge quenching on the thickness and resistivity of the resistive plate. We will also discuss and provide a preliminary model relating the dynamics of the charge carriers within the material and the discharge quenching mechanism.

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Session Classification: New detector materials