The surface Resistive Plate Counter

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The Surface Resistive Plate Counter (sRPC) is a novel RPC based on surface resistivity electrodes, a concept completely different from traditional RPCs that use electrodes characterized by volume resistivity. The electrodes of the sRPC exploit the well-established industrial Diamond-Like-Carbon (DLC) sputtering technology on thin (50μm) polyimide foils, which have already been introduced in the manufacturing of the resistive MPGDs such as μ-RWELL and MicroMegas.

The DLC foil is then glued to a 2mm thick float-glass, which is characterized by excellent planarity. The range of DLC surface resistivity explored is 0.1÷1 GΩ⁄square. The 2 mm gas gap between the electrodes is ensured by E-shaped spacers made of Delrin®, inserted without gluing at the edges of the glass supports. The electrodes sandwich is inserted in a fiber-glass box that acts as gas volume container.

In the baseline layout, the DLC is connected to the HV by a single dot connection outside the active area. With this layout, we measured an efficiency of 95-97% and a time resolution of ~1ns. In addition, exploiting the concept of the high-density current evacuation scheme, first introduced for the μ-RWELL, we realized prototypes with high-rate electrodes by screen printing a conductive grid onto the DLC film. With such a high-rate layout, 7GΩ/square DLC resistivity and 10mm grounding-pitch, we measured a rate capability of about 1kHz/cm2 with X-ray. By lowering the DLC resistivity and optimizing the current evacuation scheme, a rate capability of the order of 10kHz/cm2 seems achievable.

A DLC magnetron sputtering machine, co-funded by CERN and INFN, has recently been acquired and installed at the CERN EP-DT-Micro-Pattern-Technology Workshop. With this facility, it will be possible to realize large area (up to 1.8x0.6 m2) DLC electrodes with a resistivity spanning over several orders of magnitude (0.01÷10 GΩ/square). This innovative technology could open the way towards cost-effective, high-performance muon devices for applications in large HEP experiments for the future generation of high luminosity colliders.

The possibility of exploiting the sRPC technology for thermal neutron detection, by replacing DLC with B4C sputtered electrodes, is also under investigation for a possible use in Radiation Portal Monitors for homeland security purposes.