Fabrication of Resistive Plate Chamber using Bakelite

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Introduction

Now a days Resistive Plate Chamber (RPC) is one of the most important detectors in the High Energy Physics (HEP) experiments [1]. RPC is a gas filled detector utilizing a constant and uniform electric field produced between two parallel electrode plates made of a material with high bulk resistivity *e.g.* glass or bakelite. RPC has good time resolution (1-2 ns) and spatial resolution ($\sim$ cm). The high resistance of RPC plate limits the spark size produced after the ionization of gas due to the passing charged particle. This contribution discusses building of a RPC using bakelite (local sources) and the measurement of the surface resistivity of the detector.

Construction of RPC

Two 30 cm $\times$ 30 cm $\times$ 0.3 cm bakelite sheets are used as electrodes. After proper cleaning, a graphite coating (surface resistivity $\sim$ 500k$\Omega/\Box$) is made on the outer surfaces of the RPC to distribute the applied voltage uniformly over the entire RPC. A gap of 1 cm from the edges to the graphite layer is maintained to avoid external sparking. The inner surfaces of the two sheets are separated by a 2 mm gap. Uniform separation of the electrodes are ensured by using five button spacers of 1 cm diameter and 2 mm thickness, and edge spacers of 30 cm $\times$ 1 cm $\times$ 0.2 cm dimension, both being made of polycarbonate. Two nozzles (1 mm hole diameter in 2 mm thickness) for gas inlet and outlet, also made of polycarbonate, are placed diagonally as part of the edge spacers. All the components of the RPC is shown in Fig. 1.

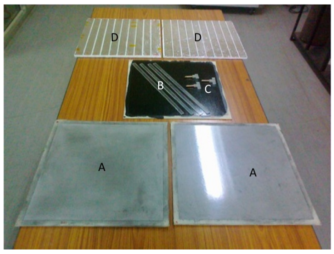

FIG. 1: Components of a RPC module: Two graphite coated bakelite sheets (A), edge spacers (B), gas nozzles (C) and pick-up strips (D).

All the spacers and nozzles are glued to the bakelite sheets using Araldite epoxy adhesive. Finally the gas gap between two bakelite sheets is made using the edge spacers and button spacers, mentioned above. The edges of the bakelite sheets are sealed by applying a layer of the epoxy adhesive to prevent permeation of moisture. Two small copper tapes $\sim$ 20 μm thick are pasted by kapton tape on both the outer surfaces (on the graphite coating side) for the application of high voltage. The high voltage connectors are soldered on these copper tapes. Mylar sheets are used on two sides of the RPC to cover the graphite coatings and to isolate the graphite coated surface and the pick-up strips [2]. The complete RPC module is shown in Fig. 2. The basic difference in the fabrication process to

*Electronic address: s.biswas@niser.ac.in,saikat.ino@gmail.com that described in Ref.[2] lies in no oil is used to make the inner bakelite surface smoother.

FIG. 2: Complete RPC module.

In order to collect the accumulated induced charges, pick-up strips are placed above the graphite coated surfaces. The pick-up strips are made of aluminium, which are pasted on one side of 8 mm thick locally available foam. The area of each strip is 3 cm $\times$ 30 cm with a separation of 2 mm between two adjacent strips. The ground plane made of aluminium, is pasted on the other side of the foam.

Surface resistivity measurement of the Graphite coating

The surface resistivity of graphite coating which is one of the important parameters for RPC is calculated measuring the leakage current. This measurement is done with the help of a jig and a multimeter. The jig is made of two 10 cm long brass rods (conductor) separated by a 10 cm long Teflon rod (insulator) and, connected in a square shape.

The principle of working of the jig is that the resistance measured for a uniform thickness, t of graphite layer will give the surface resistivity of the graphite layer. The voltage is applied in the brass (conductor) through multimeter. If ρ is the bulk resistivity of the surface of length l and cross-sectional area A then the resistance is given by,

$$R = \frac{\rho l}{A} = \frac{\rho l}{lt} = \frac{\rho}{t} \quad (1)$$

So the surface resistivity depends only on the graphite material and the thickness of the graphite layer. Since the length of the metal rods and their separation is kept same the unit of the surface resistivity is given by k$\Omega/\Box$ and it reads kΩ per square. The uniformity of the surface resistivity of graphite coating for the two bakelite electrode plates is measured moving the jig in horizontal and vertical direction on the graphite surface. For each direction 100 readings are taken. The uniformity of the surface resistivity of a plate during horizontal measurement is shown in Fig. 3. For the plate 1 the average surface resistivity is found to be $\sim$ 500 k$\Omega/\Box$ and that for the plate 2 is found to be $\sim$ 800 k$\Omega/\Box$.

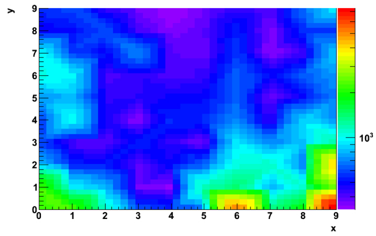

FIG. 3: The surface resistivity of graphite coated surface. x and y both dimensions are 30 cm divided into 0-9 zones.

Conclusions and outlooks

One RPC module is fabricated using bakelite electrode from the local market. The uniformity of surface resistivity is measured. The testing of the module in the streamer mode for efficiency, counting rate etc. are in future plan.

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