Impedance Measurement of Suitable Materials for INO RPC detector Pickup Strip Panels

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In this article, we focused on the selection of suitable material that can be used as a dielectric material for the INO RPC detector's pick up strip panel. We found ceramic cement as a suitable material for this purpose which satisfied all selection criteria.

Introduction

Resistive Plate Chambers are parallel plate fast gaseous detectors built using electrodes of high resistivity (~10^{12}ohm-cm) such as glass or Bakelite [1-2]. Both electrodes are connected to the positive and negative terminal of the high voltage power supply. When a charge particle such as muon passes through the chamber it ionizes the gas and charges are move towards opposite electrodes. The electrodes are transparent to the signal (the electrons), which are instead picked up by external metallic strips after a small but precise time delay. The pattern of hit strips gives a quick measure of the muon momentum, which is then used by the trigger to make immediate decisions about whether the data are worth keeping [3].

Currently used material for pickup strip panel is polycarbonate which has two major draw backs such as it is not very flexible and can burn very easily. Since INO experiment will take data underground. Therefore almost all material used should be fire resistant.

Suitable Materials for Pickup strip

The criteria for the suitable material should be a) fire resistant b) 50 ohm impedance c) flexible d) cost effective e) light weight and f) available in local market. In the light of above criteria we tested various materials and found two of them (Ceramic fiber and Ceramic foam) are very close to our requirements. Their physical properties are tabulated in the Table. We made small size pickup strip panels for these materials and study the signal shape to obtained impedance.

Experimental details

We measure the Impedance / Resistance of those materials by pulse method using pulse generator, oscilloscope and multimeter. We used polycarbonate pickup strip panel provided by TIFR group and prepared two small size pickup panels for above mentioned materials using Aluminium sheet and copper tape as shown in Figure 1. These are the new materials which are first time used by our group for making pickup strip panels.

A sine wave is applied through pulse generator at the center or any where on the pickup strip and one end is read out through oscilloscope to see the pulse shape and reflection of the pulse and other end is connected with variable resistance along with multimeter to measure change in the resistance. Experimental connection is shown in Figure 2. We have designed and tested many pickup strip panels using various materials but could not achieve the desired results.

We obtained desired results with above mentioned materials. We observed around 50 ohms resistance value for complete removal of the reflected signal as shown in Figure 3. But ceramic foam is not very comfortable in gluing with copper and Aluminium. Therefore we are infavour of making pickup strip panels using ceramic fiber.

Fig. 1: Small size Pickup strip panels of different materials (top) ceramic foam (middle) Ceramic fiber and (bottom) polycarbonate.

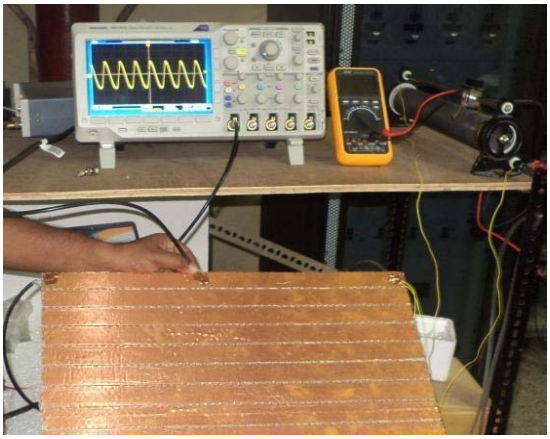

Fig. 2: Experimental setup for measurement of the resistance.

Ceramic Fiber	Fireproof, Moisture proof And Flexible	Light Weight, Density 128 Kg/m^3	Thickness 2-3 mm and impedance ~ 44 Ohm
Ceramic Foam	Fireproof, Moisture proof And Flexible	Light Weight, Density 105 Kg/m^3	Thickness 2-4 mm and impedance ~60 Ohm

Table 1: Physical properties of ceramic foam and fiber materials.

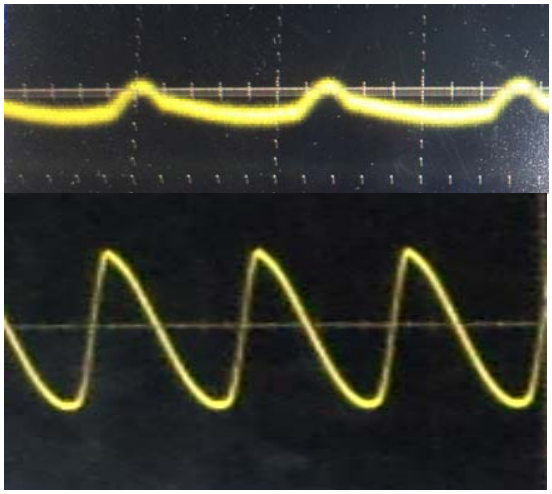

Fig. 3: Original pickup signal with reflected one (above) and signal with suitable termination (below).

Results and discussions

The resistance of these materials are measured and obtained around 50 ohm while the other materials which is used by us, the resistance are 55 ohm and 44 ohm, respectively. The ceramic foam material is seems to be suitable for the use of dielectric material in place of polycarbonate in the pickup strip panel.

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