

## Characterization of Suitable Pickup Strips Panel's Dielectric Material for RPC Detector

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### Introduction

Resistive plate chambers are parallel plate fast gaseous detectors built using electrodes of high resistivity ( $\sim 10^{12}$  ohm-cm) such as glass or Bakelite[1-2]. The signals generated in RPC gas chamber are picked up by external metallic strips after a small but precise time delay. Currently used material for pickup strip panel is a honeycomb in which polycarbonate is used as dielectric material, which has two major drawbacks such as it is not very flexible and can catch fire very easily. Since INO experiment will take data underground, therefore almost all materials used in detector or shielding should be fire resistant. Keeping in mind the above requirement we look for suitable material that must fulfill also the following criteria such as being fireproof, flexible, light weight, and cost effective.

### Material Selections

In light of the above criteria we tested various materials and found Ceramic Foam is suitable to our requirements. Properties of honeycomb and Ceramic Foam in a comparative way are shown in Table 1.

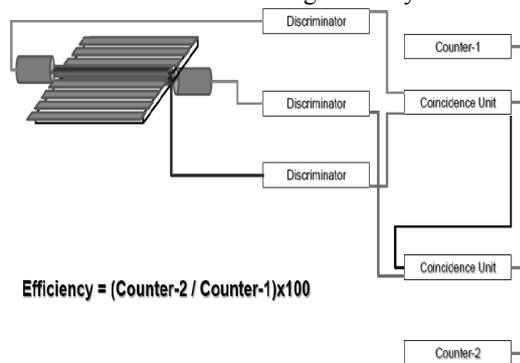
### Characteristic Impedance Measurement

As for as the electrical properties are concerned, it will be ideal to have the characteristic impedance of the strips so formed match with that of the front-end electronics, so that signal reflections and attenuation are minimized [3]. We measure the characteristic impedance of the material using function generator, oscilloscope and multimeter. We measured around 50 ohms characteristic impedance value of Ceramic foam based pickup panel. Therefore we are in favor of making pickup strip panels using ceramic foam.

### Measurement of Efficiency

We measure the efficiency of RPC Detector using a single pure Freon R134a Gas following circuit diagram as shown in Figure 1. In this

measurement we have used the charge pickup strips panel made up of Polycarbonate (Honeycomb) and also with a new suitable material Ceramic Foam as shown in Figure 2. We found that using this material the efficiency of RPC Detector is increased significantly.



**Fig. 1:** Schematic circuit diagram for the measurement of RPC detector's efficiency.

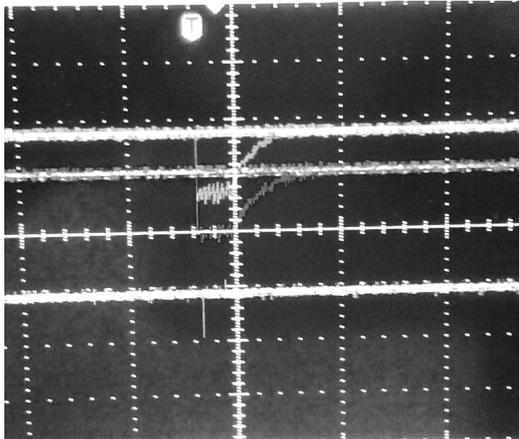
PROPERTIES	HONEY COMB	CERAMIC FOAM
Flammability	High	Zero
Flexibility	Poor	Good
Melting Temperature	155 <sup>0</sup> C	2100 <sup>0</sup> C
Dielectric constant (Er) @ 1 MHz	2.9	3.2

**Table 1:** Comparative properties of pickup strip panel's materials.



**Fig. 2:** Experimental arrangement for the efficiency measurement using finger type two plastic scintillator detectors.

The RPC Detector signal in coincidence with plastic scintillator detector signals is shown in Figure 3. This shows that RPC detector signal is generated by cosmic ray muon.

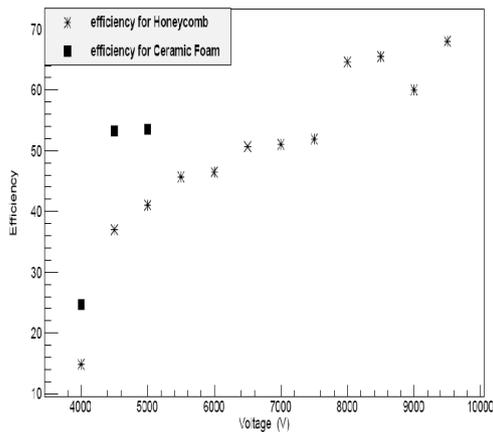


**Fig. 3:** RPC Detector pulse in coincidence with two pulses from Plastic Scintillator detectors.

We measure the variation of efficiency with applied voltage. The formula used for efficiency calculation is as follows:

Efficiency =  $(\text{Counter}_2 / \text{Counter}_1) \times 100$ . Here counter<sub>1</sub> and counter<sub>2</sub> are shown in Figure 1.

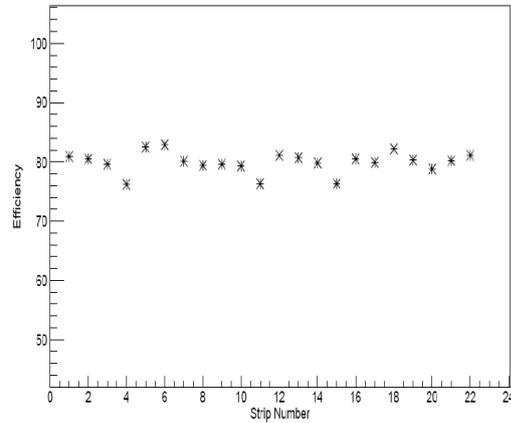
We got the following variation of efficiency with applied voltage both for Polycarbonate (Honeycomb) and Ceramic Foam materials as shown in Figure 4.



**Fig. 4:** Variation of efficiency with applied voltage to the RPC detector.

These data are taken under similar condition for Honeycomb and Ceramic foam pickup panels. For the Ceramic foam only three data points are shown. The efficiency of each pickup strips are

plotted with respect to the applied voltage in Figure 5. It shows that the efficiency of each pickup strips are almost constant around 80%.



**Fig. 5:** Efficiency of each pickup strips at a fixed applied voltage.

During this experiment a high voltage of 7 kV is applied to the RPC detector’s electrodes and a minimal gas flow of single gas R134a (Freon) used. A relative humidity ~ 40 % and temperature ~25 °C were maintained during the experiment. We could get an almost stable performance by all the pickup strips.

**Remarks and conclusions**

The Ceramic Foam is found to be good for pickup strips panels. We found that the newly designed and developed pickup strip panel is working satisfactorily. Therefore, the Ceramic foam seems to be good dielectric material for the use in pickup strip panel for RPC Detector.

**Acknowledgement**

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**References**

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