

Development and Characterisation of Bakelite RPC

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Introduction

Resistive Plate Chambers will be used as active detectors in the proposed India based Neutrino Observatory (INO) project [1],[2] and Long Baseline Neutrino Experiment (LBNE). In general, RPCs are fabricated by using glass or bakelite as electrodes. VECC is involved in the R&D, indigenously on bakelite RPCs. Here we present the test results of a bakelite sample along with the cosmic ray test results of the bakelite RPC fabricated at VECC.

Fabrication of RPC

We have fabricated [3] a single gap 30cm X 30cm X 0.2cm bakelite RPC from 0.3cm thick bakelite. A gap of 0.2 cm was maintained between these electrodes with the help of 4 button spacers of diameter 1 cm and height 0.2 cm and 4 side spacers of length 28 cm and height 0.2 cm along with two gas nozzles. The outer surface of both the electrodes were painted with conducting black graphite paint mixed with special thinner in 1:1 ratio in order to apply uniform electric field across the plates. Figure-1 shows the different components of the fabricated RPC.

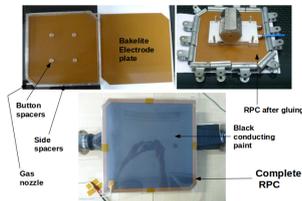


FIG. 1: Fabrication of RPC.

Results

The electrical properties like bulk resistivity and surface resistivity of the bakelite sample were measured and shown in figure 2 and figure 3. The bulk resistivity of the bakelite sample was measured to be $\sim 9 \times 10^{11} \Omega \text{cm}$ whereas the surface resistivity was measured to be $\sim 3 \times 10^{12} \Omega/\square$.

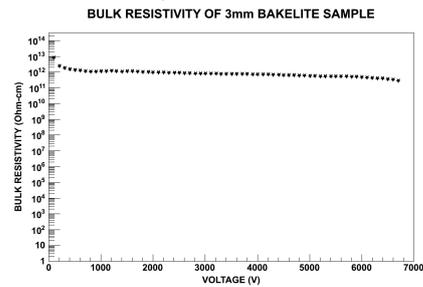


FIG. 2: Measured bulk resistivity of the bakelite sample.

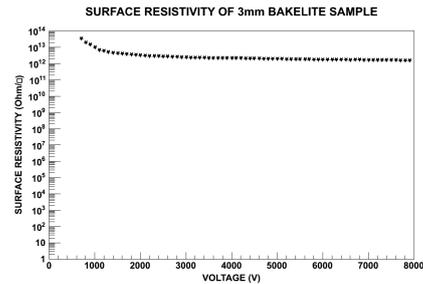


FIG. 3: Measured surface resistivity of the bakelite sample

The I-V characteristics of the fabricated bakelite RPC has been studied in streamer mode of operation with a gas composition of Argon:Freon(R134a):Iso-butane::55:40:5 is shown in figure-4. Two distinct slopes in the I-V characteristics has been obtained with a breakdown voltage $\sim 7000\text{V}$.

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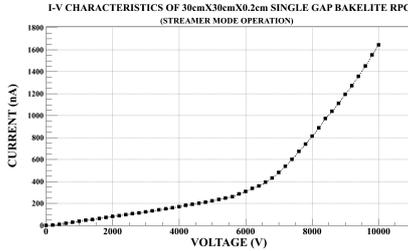


FIG. 4: I-V characteristics of the bakelite RPC

The RPC has been tested for current stability for ~50hrs at ±6000V as shown in figure-5. The efficiency and noise rate test of the

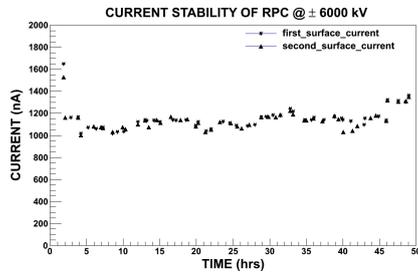


FIG. 5: Current stability of the bakelite RPC.

RPC was also measured. An efficiency plateau was obtained for the RPC beyond 8000V. The efficiency, as shown in figure-6 was found to be ~98%. During this test, noise rate of the RPC was also calculated and was found to be ~1.7 Hz/cm² at 9000V. A linearly varying behaviour of the noise rate with the applied voltage is shown in figure.-7.

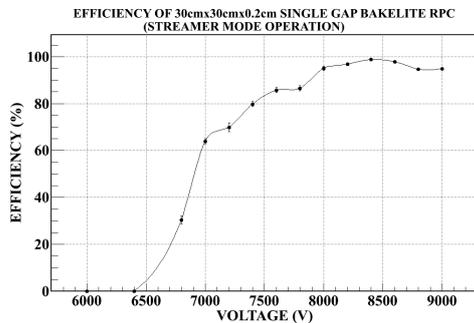


FIG. 6: Efficiency of fabricated the bakelite RPC

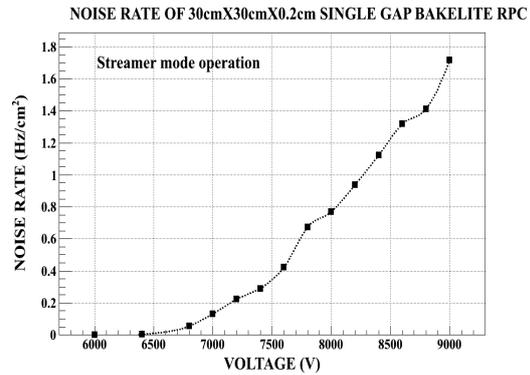


FIG. 7: Noise rate of the bakelite RPC

Conclusion

To conclude, the electrical properties of the new bakelite were found promising. A single gap bakelite RPC of dimension 30 cm X 30 cm X 0.2 cm has been fabricated and tested with cosmic rays for current stability, efficiency and noise rate. The test results were satisfactory and hence this sample can be used to fabricate large size (~2 m X 2 m) bakelite RPC for the proposed INO project.

References

- [1] R. Santonico R.Cardarelli, Nucl. Inst. and Meth. 187, (1987) 331.
- [2] INO Project Report, INO/2006/0, May 2006, <http://www.ino.tifr.res.in/ino>.
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