Performance of low resistive glass

Yi Wang, J. Wang, W. Ding, and H. Chen
Department of Engineering Physics, Tsinghua University, Beijing, China

The counting rate capability of MRPCs is strongly dependent on the resistivity of glass. A kind of low resistive silicate glass with bulk resistivity of the order of 10^{10} Ωcm were produced in Tsinghua University. The architecture of melting, annealing and polishing is very important to get high quality glass. Fig. 1 shows the bulk resistivity as a function of position. Although the resistivity changes a little in different position, it is still of the order of 10^{10} Ωcm.

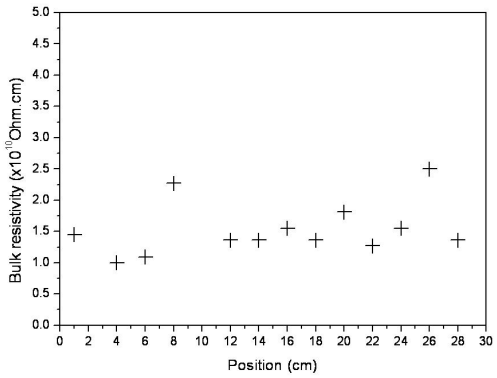

Figure 1: Bulk resistivity as a function of position. The dimension of the glass is 20 cm × 30 cm × 1.1 mm.

Temperature and high voltage tests are shown in Fig. 2, which shows that this kind of glass has very good performance.

In order to get the surface quality of the glass, 2-D and 3-D scanning were done. Because the glass was polished by precise machines, the surface is very smooth and its roughness is less than 10 nm.

The stability with respect to time and integrated charge of the electrical properties of the electrode materials was shown to be a drawback in some previous attempts, so we have focused on this aspect. Fig. 3 shows the stability test of the glass resistivity with respect to the charge integrated across it. The test was done at 28°C for 34 days, with an applied voltage of 1 kV. The accumulated charge was 1 C/cm^2, roughly corresponding to the CBM life time over 5 years of operation at the maximum particle flux of about 20 kHz/cm^2. Despite the main conductivity being electronic, an increase of the bulk resistivity with time/charge can be seen, not exceeding a (tolerable) factor of 2, even for such large integrated charges.

The specifications of the low resistivity glass are shown in Table 1.

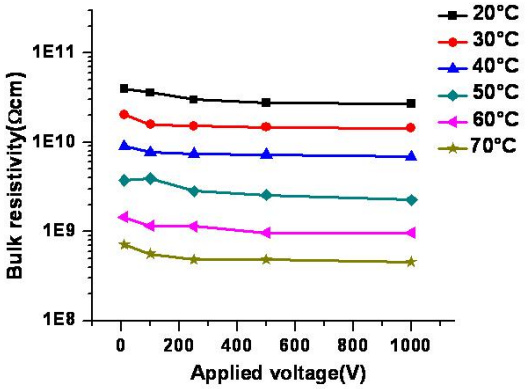

Figure 2: Bulk resistivity of the low resistive silicate glass as a function of applied voltage at various temperatures

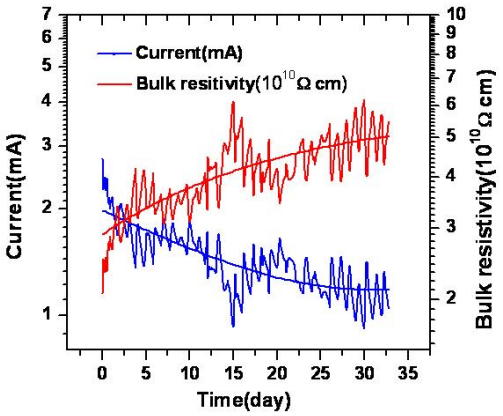

Figure 3: Long term stability test of the low-resistive silicate glass for 34 days: current (lower line) and bulk resistivity (upper line) as a function of time at 28°C, for an applied voltage of 1 kV. The total integrated charge across the material was 1 C/cm^2.

Table 1: Specification of glass

Maximal dimension	50 cm x 50 cm
Bulk resisitivity	$\approx 10^{10}$ Ωcm
Standard thickness	0.5 mm - 2 mm
Thickness uniformity	± 0.02 mm
Dielectric constant	≈ 10
Surface roughness	< 10 nm
DC measurement	very stable