GRPC construction and graphite coating

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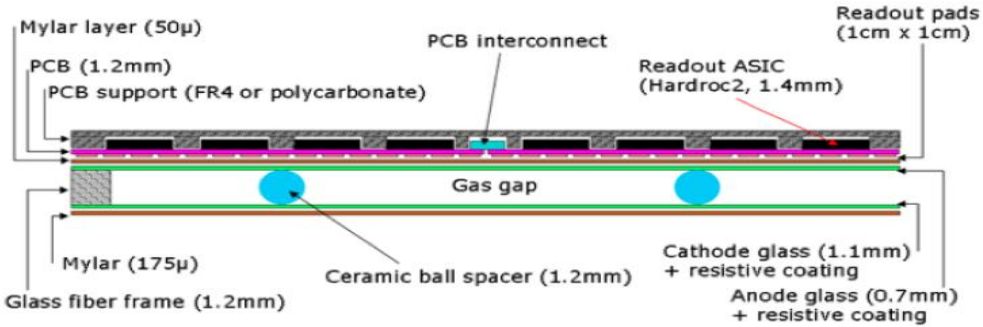
Outline

- 1. GRPC construction
- 2. Graphite coating
- 3. Assembly and signal testing
- 4. Summary and next plans

1. GRPC construction

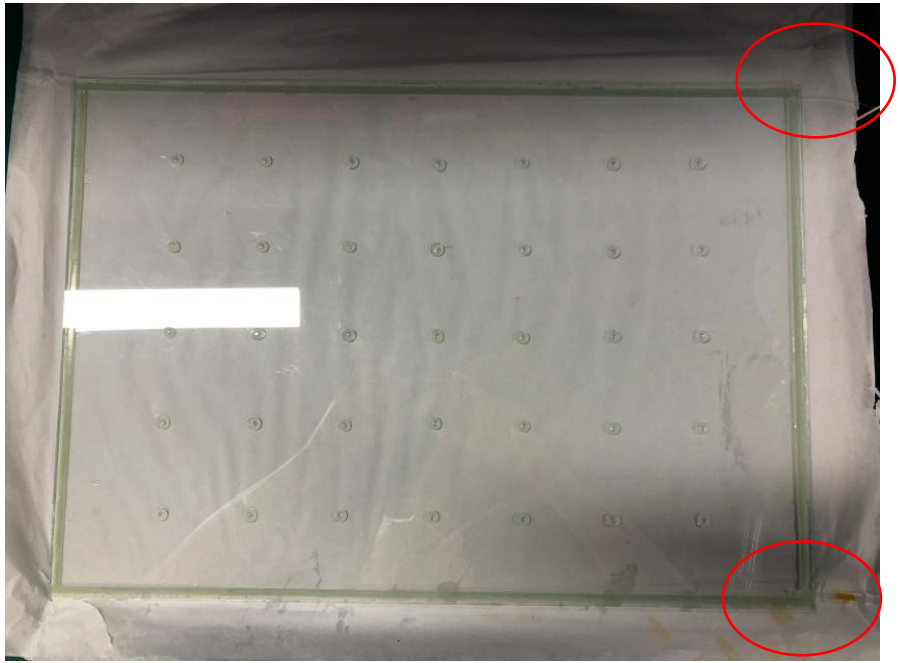
A large prototype of 1.3m^3 was designed and built as a demonstrator of the semi-digital hadronic calorimeter (SDHCAL) concept proposed for the future ILC experiments. The prototype is a sampling hadronic calorimeter of 48 units. Each unit is built of an active layer made of 1m^2 Glass Resistive Plate Chamber (GRPC) detector placed inside a cassette whose walls are made of stainless steel.



Items	thickness
Anode glass plate	0.7mm
Cathode glass plate	1.2mm
Gas gap	1.2mm
Mylar foil	0.05mm

Cross-section through a 1m^2 chamber.(SDHCAL Design)

1. GRPC construction



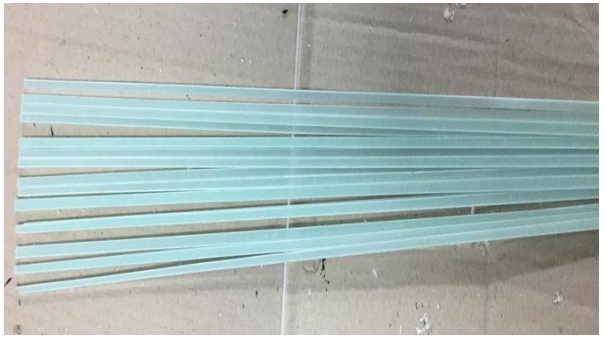
Made in SJTU. One inlet and 3 outlets.

Inlet (left) and outlet (right) capillaries for gas transport. (SDHCAL)

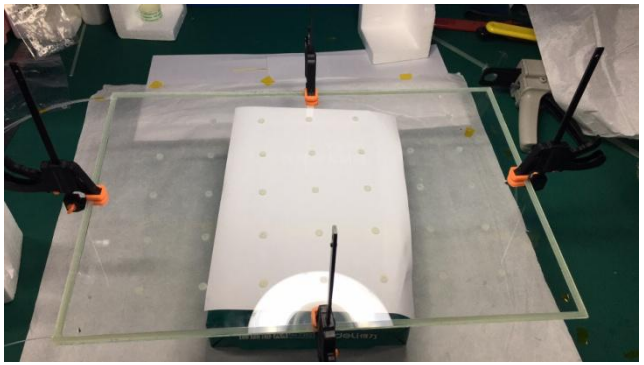
The capillaries have 1.2mm external diameter with a 0.2mm wall thickness. A single capillary is used for the inlet whereas the outlet consists of 5 capillaries to minimize the pressure drop, thus minimizing the pressure inside the chamber.

1. GRPC construction

In the GRPC production process, we solved many problems, such as the bending caused by the mismatch between the spacers and the FR4 size, and the sliding of the spacers caused by the inconvenience of the two glasses.



Size of new FR4: 1m×4mm×1.2mm
Tolerance: <50um,
Uniform thickness

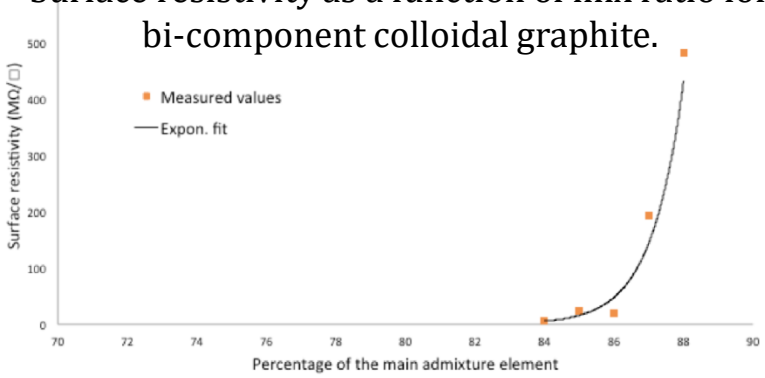


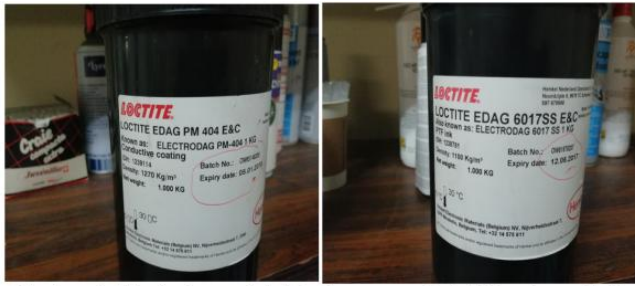
Press the edge by clamp

Use acrylic plates and magnets to fix the glass for easy attachment of two pieces of glass

2. Graphite coating

Surface resistivity as a function of mix ratio for bi-component colloidal graphite.





https://www.henkel-adhesives.com/us/en/about/our-brands/loctite.html
Type I : LOCTITE EDAG PM 404 E&C (240.90euro/kg)
Type II : LOCTITE EDAG 6017ss E&C (240.90euro/kg)

Contact information provided by Imad.
Christine Deleu
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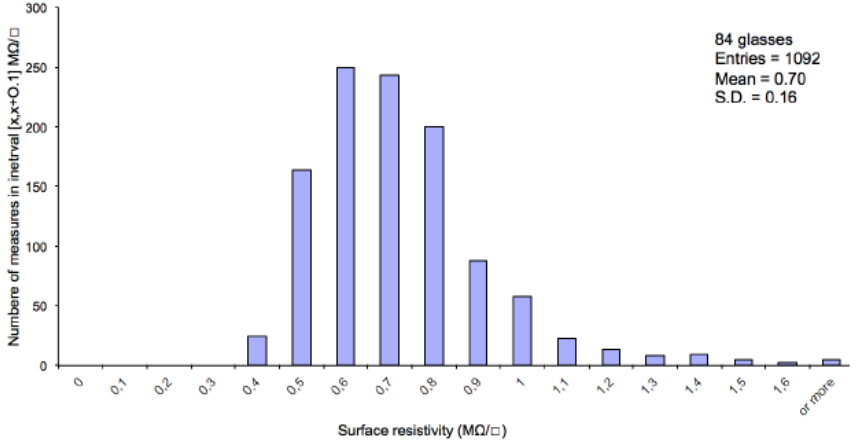
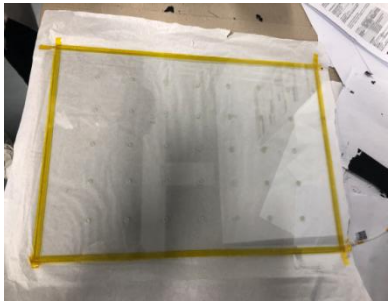
Tetrachim Distribution

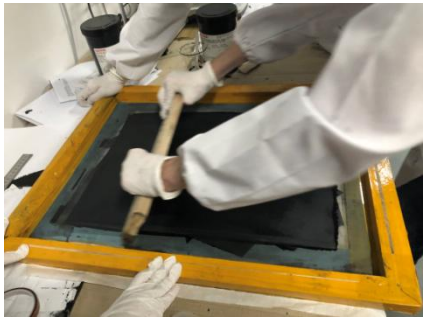
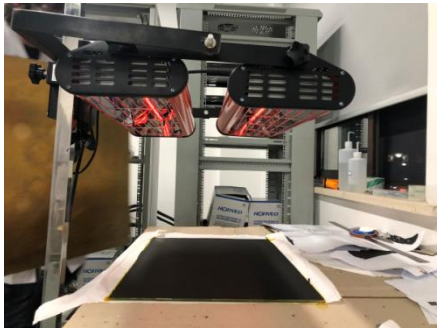


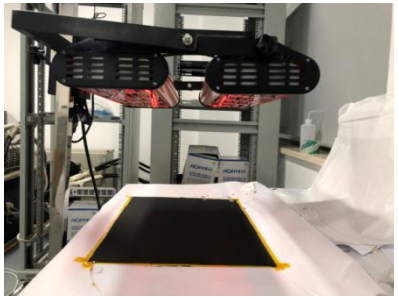
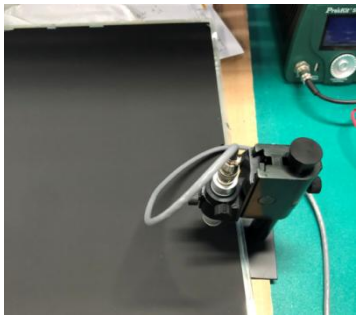
Distribution of average surface resistivity for 84 of 1m^2 glasses coated with bi-component colloidal graphite. Each coated surface has been measured at 13 locations. Three surfaces are responsible for most of the values above 1.2MΩ/□ and are not used for the computation of the mean and standard deviation.

arXiv:1506.05316v2 [physics.ins-det] 24 Oct 2015

2. Graphite coating

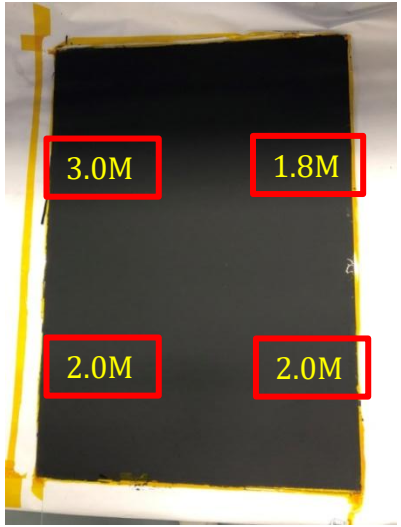


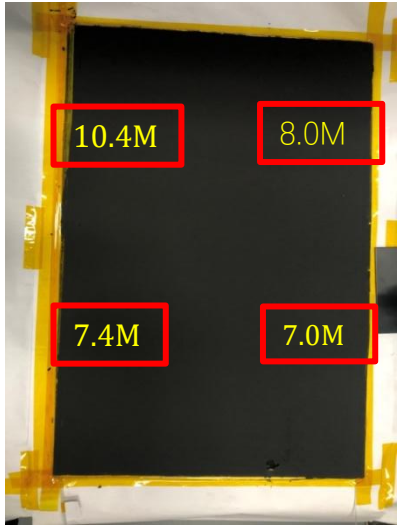



RPC Size: 500*350*1.2mm^3
Silk thickness: 70 μm
Silk size: 300mesh/in
Temperature: 70℃(middle)
50℃(four corners)
Time: 2hours(each side)
Graphite ratio: 83% 84%

2. Graphite coating



Graphite ratio: 83%

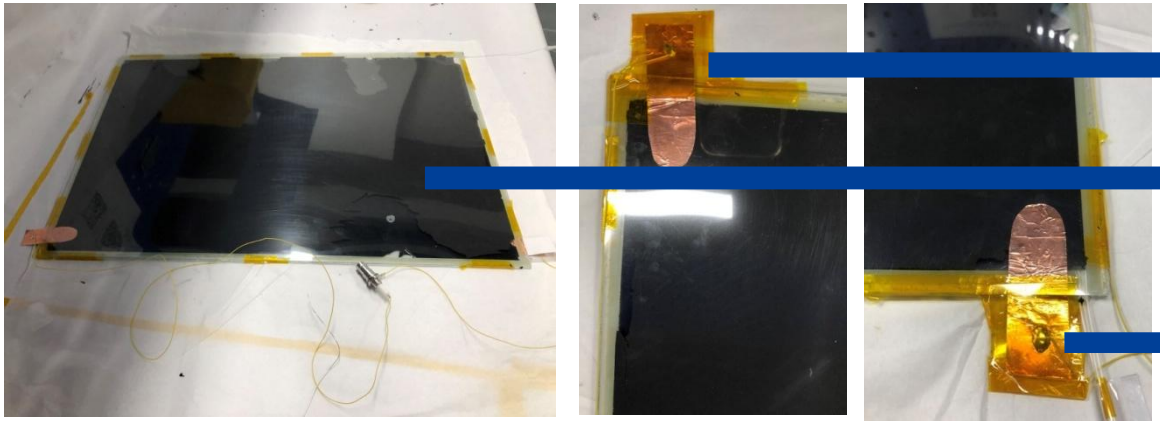


Graphite ratio: 84%

1. The graphite layer with a graphite ratio of 83% is thinner and the edges are peeled off. The possible reason is that ethanol droplets remain on the screen during the printing process.

2. The resistivity of the graphite layer is not very uniform.

3. Assembly and signal testing



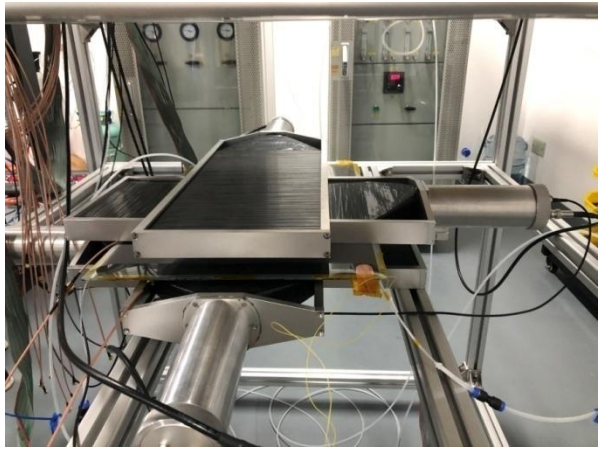
Anode

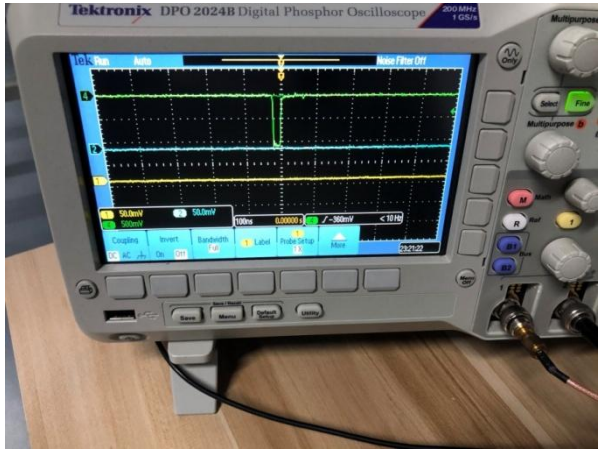
Mylar foil:0.188mm

High voltage cathode

readout strip(2 channels)

3. Assembly and signal testing





No signal

- resistivity
- Poor circuit contact

1. Gas system ——The main ingredient is R134a. Because the mass flow controller of iso-butane doesn't work.
2. Voltage and current —— 6400V 0.3-0.6uA

Summary & Plans

1. We can already make a good 50*35cm GRPC. The next step is to optimize the GRPC manufacturing process, making the GRPC easier to make, the size control is more reasonable, and the glass surface is cleaner.
2. We have successfully sprayed graphite by screen printing, but we need to further increase the adhesion of graphite and a more stable and uniform resistivity.
3. We need to improve gas and test systems for more signal testing.

Thanks