Viewer Plates for Low-Energy and High-Intensity Beams from Ion Sources

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At the downstream of the ion sources, the accelerating voltages are as low as 10 kV and the currents are higher than tens μA. If it is possible to directly observe the profile of the full beam without the use of attenuators, we can tune the ion source and the beam transport system much easier. For this purpose, viewer plates were developed to observe the profile of beams from the ion sources.

The viewer plates were mounted on a vacuum sealed drive that inserts the plate into the beam. A CCD camera was mounted to observe the plate through a clear glass window and the image was stored in a PC for offline analysis. The plates were made of 1 mm thick cupper. On the plate, 1 mm holes were arranged on the vertical and the horizontal axes at a 10 mm pitch to give a size reference.

Two kinds of materials were tested. They have been used at NSCL, Michigan State University [1].

1) Potassium Bromide KBr

The salt of KBr of 25 g in weight was dissolved throughly in 50 ml distilled H_2O to make a saturated solution. The cupper plate was heated to 100°C on a hot plate. The solution was then sprayed on the heated surface with an airbrush to make a thin layer of KBr and dryed at 100°C. The process was repeated several times.

2) Barium Fluoride BaF_2

Sodium Silicate, a water glass, of 5.3 g was diluted with 8 ml distilled H_2O. The BaF_2 salt of 16 g was mixed throughly in the water glass. The plate was fixed on a cardboard. The solution was sprayed with an airbrush at the room temperature in a drafter. Since BaF_2 is poisonous, the treatment should be carefully done using protective glasses, gloves and a masks for safety. The surface of the plate became wet and was colored white. The plate was dryed at 70°C, 100°C and 120°C for 20, 60 and 60 minutes, respectively. It was important to dry the plate slowly as well as completely in order to get a good performance.

They were tested to observe several tens/hundreds μA beams at the extraction voltage of 10-15 kV from the ion source. The KBr plate showed a higher light output than the BaF_2 one and both were applicable to the case of the test condition. Figure 1 shows a viewer plate mounted on a drive. Figures 2 and 3 show the observed beam profile with the KBr and BaF_2 viewer plate, respectively.

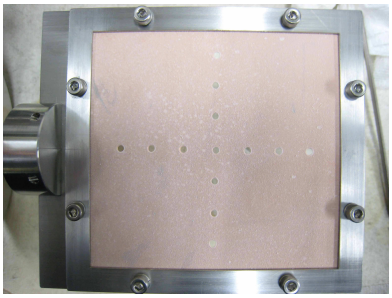

Figure 1. Viewer plate mounted on a vacuum sealed drive.

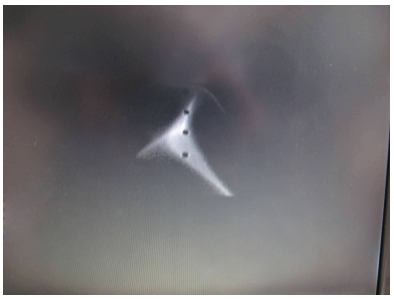

Figure 2. Proton beam profile observed by the KBr viewer plate at the downstream of the NEOMAFIOS. The intensity was 10 μA at 15 kV extraction voltage.

Figure 3. $^4He^{2+}$ beam profile observed by the BaF_2 viewer plate at the downstream of the NEOMAFIOS. The intensity was 200 μA at 15 kV extraction voltage.

References

[1] Jeffry W. Stetson, private communication.