Abstract

Currently, the 28 GHz electron cyclotron resonance ion source (ECRIS) has been developed to produce a high current heavy ion at Korea basic science institute (KBSI). The high voltage platform of 28 GHz ECRIS is essential to deliver an ion beam to the next acceleration stage. In order to ensure the electrical safety, the high voltage platform has been designed considering dielectric characteristics. In this paper, a study on the dielectric characteristics of glass fiber reinforced plastic (GFRP) is performed to determine the thickness of GFRP tube located between plasma chamber and inner bore of cryostat. The dielectric experiments on GFRP tube are conducted under DC voltage. Sphere-to-plane electrode systems are used to examine the dielectric characteristics. Also, the relationship between the dielectric characteristics of glass fiber reinforced plastic (GFRP) tube insulation material and the distribution of electric field intensity is calculated and analyzed by the finite elements method (FEM).

Experimental Set-up

- In this paper, experiments on the sparkover breakdown voltage are conducted to verify the dielectric characteristics of GFRP tube insulation material.
- Fig. 1. show the schematic drawing of the experimental set-up.

![Fig. 1. The schematic drawing of the experimental set-up.](image)

**Electrode material** | **Aluminum**
---|---
**Sphere Electrode** | Diameter 100mm, Thickness 10mm, radius of curvature 5mm at edge 1mm
**Plane Electrode** | Diameter 80mm, thickness 10mm, radius of curvature 5mm at edge
**Thickness of GFRP** | 1mm

**Table 1.** $E_{BD,MAX}$ and $E_{BD,MEAN}$ of GFRP tube insulation material.

<table>
<thead>
<tr>
<th>$E$</th>
<th>$E_{BD,MAX}$</th>
<th>$E_{BD,MEAN}$</th>
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<tbody>
<tr>
<td>Voltage</td>
<td>56.2 kV</td>
<td>88 kV</td>
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</table>

Conclusion

- Experimental results on GFRP tube insulation material were analyzed by FEM simulation.
- The functional relations between electric field intensity and $\zeta$ were expressed as exponential equations.
- As a result, it was found that the dielectric characteristics of GFRP tube insulation material (thickness 1 mm) could be explained by not only $E_{BD,MAX}$ but also $E_{BD,MEAN}$.
- Finally, the dielectric design of high voltage platform for developing 28 GHz ECRIS can be conducted by applying the deduced empirical formulae.
- We also plan to analyze various dielectric material of the high voltage platform.

![Fig. 2. The $V_{BD,MAX}$ of GFRP tube insulation material according to various diameter of the sphere electrode.](image)

![Fig. 3. $E_{BD,MAX}$ and $E_{BD,MEAN}$ at sparkover of GFRP tube insulation material according to $\zeta$.](image)

![Experimental Results](image)