Contribution ID: **19** Type: **Poster Presentation**

A coaxial ceramic vacuum insulator for a repetitive operated pulsed power source

Wednesday 6 July 2016 14:40 (20 minutes)

Research on the surface flashover of the vacuum interface under pulsed voltage is significant for the design and operation of pulsed power devices. The interface problem is difficult because the electrical, mechanical and vacuum issues that must be satisfied simultaneously. In this paper, a coaxial high-voltage vacuum interface based on ceramic-metal welding has been designed and tested with a repetitive pulsed power modulator. Results from electro-static and mechanic-stress calculation by the ANSYS package show that the electric field (E-field) distribution along the ceramic surface is uniform and the structure strength is under control. Key structures such as the anode and the cathode shielding rings for ceramic solders have been optimized to significantly reduce E-field stresses around the triple junctions. Aging experiments with this insulation structure were conducted in the condition of ˜600 kV, ˜60 ns and 1˜10 Hz pulses. The statistical method was used to evaluate the reliability of the insulator performance and results show that the ceramic vacuum interface can work stably with the hold-off field of more than 45 kV/cm. Furthermore, by sampling and scanning the different surface condition of the ceramic insulator, the influence of the ceramic surface roughness on the flashover characteristics was also analytical discussed.

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Session Classification: Poster 1-B

Track Classification: Dielectrics, Insulation, and Breakdown