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Characteristics of Residual Surface Charge Distribution on Alumina under DC Voltage in Vacuum

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For dielectric-vacuum compound insulation systems, the discharges usually occur across the insulator surface with an onset voltage much lower than the breakdown voltage for vacuum gap of the same length. It is no wonder that the surface charge accumulated on the insulator plays an important role in the flashover process in vacuum, especially under DC voltage. In this paper, the off-line observation of residual surface charge on alumina under DC voltage in vacuum was carried out by a Kelvin electrostatic probe. Measured results suggested that the dielectric surface was positively charged when the tangential electric field was much stronger than the normal component, for both the positive and negative voltage. However, when the normal electric field was strong enough the dielectric surface would be negatively charged. These results clearly supported the secondary electron emission avalanche (SEEA) theory as a mechanism of surface charging of an insulator in vacuum. Besides, the flashover voltage for different electric field distribution, with adjusting the electrode radius for cathode and anode, demonstrated that the surface insulation strength could be improved by appropriately enhancing the field at anode triple junction (ATJ). This research might be of great help to make a better understanding of the role of surface charging in flashover process, and probably to put forward new measures for increasing the surface flashover voltage.

Primary author: Mr SU, Guo-Qiang (State Key Laboratory of Electrical Insulation and Power Equipment, School of Electrical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, China)

Co-authors: Mr SONG, Bai-Peng (State Key Laboratory of Electrical Insulation and Power Equipment, School of Electrical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, China); Mr GUO, Bao-Hong (State Key Laboratory of Electrical Insulation and Power Equipment, School of Electrical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, China); Mr ZHANG, Guan-Jun (State Key Laboratory of Electrical Insulation and Power Equipment, School of Electrical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, China); Mr WANG, Yi-Bo (State Key Laboratory of Electrical Insulation and Power Equipment, School of Electrical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, China)

Presenter: Mr ZHANG, Guan-Jun (State Key Laboratory of Electrical Insulation and Power Equipment, School of Electrical Engineering, Xi'an Jiaotong University, Xi'an, Shaanxi 710049, China)

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