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Surface Dielectric Characteristics of GFRP and PTFE in Cryogenic Environment under the Switching Impulse Superimposed on DC Voltage

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Since superconducting technology has advantages of high efficiency, large capacity, and eco-friendliness, HVDC superconducting power devices such as superconducting cable, transformers, fault current limiters, and magnetic energy storage are being extensively studied. The creepage distance of solid insulator is very important for the reliable and economical insulation design of the HVDC superconducting power device. The switching impulse superimposed on DC voltage, can cause critical stress to the insulation of HVDC superconducting power device and can potentially result in breakdown. Therefore, the solid insulator of HVDC superconducting power device must have sufficient creepage distance to avoid breakdown under switching impulse superimposed on DC. In this paper, the surface flashover experiments were performed by applying switching impulse superimposed on dc to glass fiber reinforced polymer (GFRP) and polytetrafluoroethylene (PTFE) specimen in cryogenic environment. The surface dielectric characteristics were analyzed according to the creepage distance and polarity of the applied voltage. From the experimental results, we concluded that increasing the creepage distance resulted in an increase in surface flashover voltage. The surface dielectric strength of GFRP was found to be higher than PTFE. In addition, surface flashover voltage was lower in case of superposition of same polarity voltage compared to the opposite polarity voltage. Therefore, the optimal creepage distance design of solid insulator in HVDC superconducting power device is possible by taking into account the same polarity superposition.

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