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Trap Energy Distribution of PPLP according to PP ratio at cryogenic temperature

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High-temperature superconducting (HTS) cables are rapidly developed for their increased transmission capacity and reduced power transmission losses, and PPLP with excellent low-temperature dielectric and mechanical characteristics is used as insulation materials for HTS AC cables. However, unlike AC, since the direction of the electric field does not change in the DC environment, the space charges are accumulated in the insulation materials, which distorts the electric field distribution and can cause partial discharge and electrical breakdown even at a low applied voltage. Especially, the space charges accumulate well at the interface between different materials, for the use of PPLP with several kinds of the interface in HTS DC cable, the research on space charge is essential. Although the study of space charges for PPLP at room temperature has been actively conducted, the study of space charges at cryogenic temperatures should be still needed. In this paper, the trap energy distribution of PPLP according to PP ratio at cryogenic temperature was analyzed. The space charge of PPLP for superconducting DC cables was studied by measuring isothermal relaxation current (IRC). The IRC theory is a way to know about the trap energy density of space charges by measuring the current generated during the trap and de-trap process. The measurement was conducted using an electrometer by applying a constant electric field in the liquid nitrogen (LN2). The measured current consists of polarization current and leakage current, the trap energy distribution was calculated from the polarization current, and the conductivity was calculated from the leakage current. And the optimum ratio of PP with the lowest trap energy density was derived by varying the thickness of PP and Kraft paper while keeping the total PPLP thickness constant. Also the trap energy distribution and conductivity according to the applied electric field were compared for each thickness ratio.

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