Partial Discharge Measurements of Artificial Defects of HTS Transformer Model Using HFCT

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Recently, various high-temperature superconducting (HTS) devices have been developed and prepared for field tests and commercial applications. One of the promising HTS devices for electric network is superconducting transformers. Comparing to conventional power transformers, it could offer several advantages such as reduced size and weight, high efficiency, no oil, nonflammable and free from environmental hazards. For HTS power applications, especially for low temperature, high voltage environments, it was inevitable to cope with cryogenic dielectric issues including low temperature breakdown of materials, partial discharges in Liquid Nitrogen, ageing of dielectric materials, cracks due to cool-down and warm-up situations and bubbling effects due to quench of superconductors.

Partial discharge measurements in cryogenic dielectric materials of HTS transformer are very important because partial discharge was regarded as primary source for ageing and breakdown of cryogenic materials. But, partial discharge measurement techniques and its effects in low temperature high voltage environments were not suggested and there exist only a few reports on this research fields. Therefore, in order to implement reliable HTS transformers, partial discharge diagnosis techniques for cryogenic materials of HTS transformers were investigated using partial discharge PD pattern analysis methods.

In this works, four different types of artificial defects including turn to turn insulation, free moving particle, void and protrusion, have been fabricated since it was commonly regarded that they might cause the sudden service failures of the power apparatus. For this purpose, these defects are installed into the dielectric materials in liquid nitrogen and experimental investigations have been carried out for the diagnosis of HTS transformer. And various PD patterns caused by the amount of quench of superconductors were analyzed. Throughout this works, the different PD patterns in cryogenic dielectric materials in liquid nitrogen, and PD measuring technique could be the fundamental steps to establish diagnosis technologies of HTS transformer for power applications

Keywords : superconducting transformer, partial discharge, HFCT