

AC Loss and Screening Current Induced Magnetic Field Analysis for Double Pancake HTS Coil using Homogenization FEM Model

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AC loss or magnetization loss is generated in HTS magnets by the varying magnetic field and transport current. Estimation of the AC loss is important during charging the HTS magnet to ensure the thermal stability. There have been many research works to estimate the AC loss by modeling HTS layer by calculating the current distribution. In this case, magnetic field formulation model is preferred rather than the magnetic vector potential model of conventional FEM tools because of the convergence speed of highly nonlinear HTS characteristic. Since the analysis model gives the current distribution in the HTS layer, SCF (Screening Current induced magnetic Field) can be also estimated and it can be used to calculate the remanent magnetic field for the HTS insert of NMR magnet.

Estimation on AC loss in HTS magnet can be carried out considering the stacked HTS conductors, however, it requires long computation time as the number of stacks increase and it is almost impossible to estimate AC loss of large HTS magnets by modelling the whole HTS conductors. To overcome the computation time problem, homogenization model was suggested by Zeromeno and showed the dramatically increased calculation efficiency while keeping the reasonable accuracy.

This paper describes the AC loss and SCF of the DPC (Double Pancake Coil) by an appropriate FEM approach, which uses the non-linear characteristic of HTS conductor. The analysis model is based on the 2-D FEM magnetic field formulation with the homogenization modeling of the coil domain. The analysis results are compared with the experimental results of AC loss and remanent magnetic field.