Contribution ID: **28** Type: **not specified**

Three-dimensional electromagnetic field analysis model for ac loss calculations of HTS coils in superferric magnets

Tuesday 12 December 2017 10:50 (30 minutes)

In order to reduce the electricity consumption of rapid cycling synchrotrons, we are studying the feasibility of superferric magnets using high Tc superconductors (HTS). Because magnets for rapid cycling synchrotrons are required to generate time-dependent magnetic fields, the ac loss reduction of HTS coils as well as the magnetization loss reduction of iron yokes is one of the key issues. In this paper, we focus on the ac losses in HTS coils and report a model for electromagnetic field analysis model to calculate their ac losses.
The ac loss in the HTS coil in a superferric magnet is determined by the combination of the self magnetic field generated by the coil current itself and the externally-applied magnetic field generated by the magnetized iron yoke. In order to calculate the ac loss in the HTS coil, firstly, the external field (magnetic flux density) distribution in the HTS coil is calculated. We calculate it by substituting the magnetic field generated by the HTS coil only from the magnetic field generated by the HTS coil and the iron yoke. Each magnetic field is calculated by using OPERA (TOSCA) considering the nonlinear magnetic characteristic of the iron but not considering the nonlinear conducting characteristic of the superconductor, i.e. assuming the uniform current distribution in HTS tape. Secondly, the dependences of electric field –current density (E–J) characteristic of HTS tape on magnitude and orientation of magnetic flux density and temperature are formulated based on measured data. Finally, three-dimensional electromagnetic field analyses of the coil are carried out using the formulated E–J characteristic and the calculated external magnetic field distribution, and, then, ac losses are calculated from the temporal evolution of electromagnetic field. In order to reduce computational memory and computation time for three-dimensional analyses, we use the hierarchical matrices method.

This work was supported by the Ministry of Education, Culture, Sports, Science and Technology under the Innovative Nuclear Research and Development Program.

Primary author: SOGABE, Yusuke (Kyoto University)

Co-authors: TOMINAGA, Naoki (Kyoto University); Mr KAWANISHI, Eiji (Kyoto University); Mr IKEDA, Tatsuya (Kyoto University); AMEMIYA, Naoyuki (Kyoto University)

Presenter: SOGABE, Yusuke (Kyoto University)

Session Classification: Session VI