APP1-6

Theoretical Evaluation of AC Losses and Screening-Current-Induced Fields in HTS Insert for High Field Magnet

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AC losses and screening-current-induced fields (SCFs) in a high temperature superconducting (HTS) insert for high field magnet are evaluated theoretically. The HTS insert is composed of stacked pancake coils, which are wound using two-ply conductors, where the superconducting-layer sides of two rare-earth-based coated conductors are attached to each other without electrical insulation. The theoretical formulas of AC loss and SCF in the two-ply conductor are derived for the simultaneous applications of a transport current and an external magnetic field parallel to its broad face. The obtained formulas consist of three terms, the contributions from the external field, transport current and gap between the superconducting layers. In order to evaluate the influence of the radial component of applied magnetic field on the magnetization in pancake coil, the electromagnetic-field distribution of stacked two-ply conductors exposed to only the external field is calculated numerically by means of a two-dimensional finite element method. The AC losses in the two-ply conductors a little far from the ends of stacked conductors can almost be reproduced with the theoretical formula as a result of the magnetic interaction between the conductors. By taking into account the magnetic-field profile in the HTS insert and the magnetic-field dependency of critical current density in the coated conductor, the AC losses and SCFs are estimated using the theoretical formulas for monotonical increase in a central field up to 25.5 T in 60 minutes in combination with low temperature superconducting outsert coils. In the case where the gap between the superconducting layers is 40 μm, the parallel-field loss becomes 17 W in maximum at about 10 minutes, which could be cooled by using prepared cryocoolers, after that, it monotonically decreases due to the decrease in the critical current density. The SCFs produced by the axial magnetic moments in two-ply conductor windings of the HTS inserts are positive, and it might be expected that the center fields in the high field magnets become a little larger than the design value.

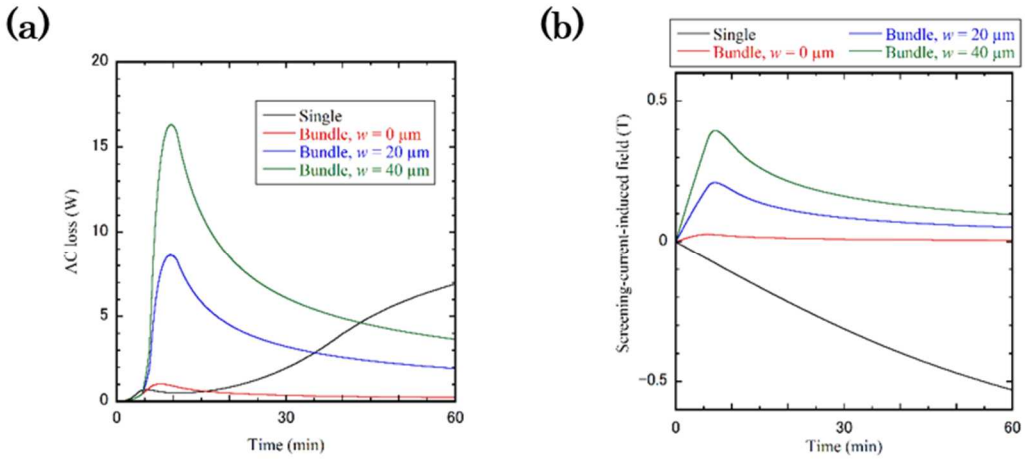

Fig. (a) AC losses in HTS inserts, (b) SCFs in HTS inserts

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