Electromagnetic Characteristics of Superconducting Coils Exposed to Travelling Magnetic Fields

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Abstract

Two-generation superconducting coils carrying large current in alternating magnetic fields is very common in electrical applications such as HTS linear motor. So it is meaningful to study the characteristics of coated superconductors in the presence of travelling magnetic field. In this paper, by using the finite element simulation software COMSOL Multiphysics® software, the characteristics of coated superconductors in the presence of travelling magnetic fields generated by three-phase alternating current are studied. In the PDE model, the so-called homogenization technique with the non-linear E-J constitutive law effectively treats the intractable width/thickness aspect ratio of coated superconductor, which results in a great difficulty in meshing the superconducting coils with considerable turns. At the same time, the temperature field is taken into consideration in the electromagnetic model to allow for the field- and temperature-dependent critical current Jc. Integral constraint is used to impose the DC current to the superconducting coil and three-phase symmetric alternating current to the ordinary copper winding, thus providing needed background magnetic field for the studied superconducting coils. Considering the actual linear motor structure, periodic boundary conditions are added; to achieve the movement of the superconducting coils, general extrusion is adopted. Based on the results of simulation, this paper discusses the current density and magnetic field distribution around superconducting coils, studying the electromagnetic forces exerting on the superconducting coils, which serves as the fundamentals of studying the thrust property of a linear traction system with coated superconductor as the excitation system, which provides a reference for the design and application of linear motor.

Reference

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Figures used in the abstract

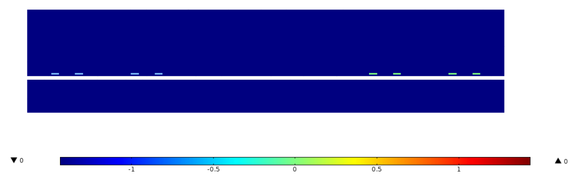

Figure 1: Magnetic field distribution aound the superconducting coil

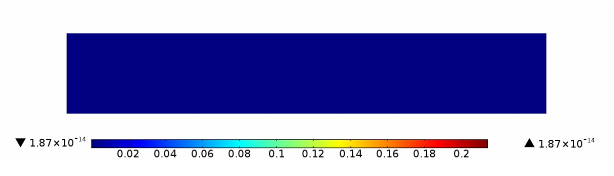

Figure 2: Magnetic field distribution of superconducting coil

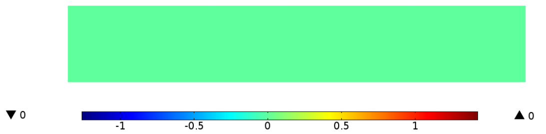

Figure 3: Current density distribution of superconducting coil

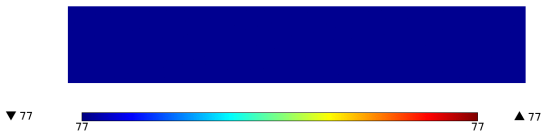

Figure 4: Temperature field distribution inside superconducting coil