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The influence of friction between layers of coil on the magneto-mechanical behaviors of YBCO superconducting magnet

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Abstract: The YBCO superconducting coils will cause complex deformation, and even moving between layers under the large Lorentz forces during energization. These will further disturb the magnetic field quality and the operating safety and stability. A more accurate estimation of the magneto-mechanical behaviors of YBCO coil during excitation is a crucial one. However, the conventional finite element modeling (FEM) no considering friction effects between the layers of coils based on the isotropic homogenized approach, which is difficult to predict accurately the magneto-mechanical behaviors of YBCO superconducting magnet, due to the heterogeneous and multilayer structure characteristics of YBCO superconducting coil. In this paper, the magneto-mechanical behaviors of YBCO superconducting magnet was numerically analyzed by using FEM with friction effect between the layers of coils. To give a more accurate prediction on the composite structure of coil, the FEM utilized an orthotropic homogenized approach to connect the micro-scale of YBCO superconducting composite tapes to the macro-scale of YBCO superconducting coil based on RVE method. The simulations show that the FEM with friction effect between the layers of coils predictions on magneto-mechanical behaviors of the YBCO superconducting coils are in better agreement with the experimental data compared to the model without friction effect.

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