

Sensitivity analysis on material properties in mechanical analysis of YBCO tapes during axial and transverse loading

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High Temperature Superconductor (HTS) tapes are expected to enable future magnets to reach magnetic fields beyond 20 T. Detailed knowledge on how these composite coated conductors behave is needed to design reliable magnet applications. The mechanical strain causes the YBCO layer within the tape to degrade, meaning that its critical current I_c drops, leading to under-performing devices. The mechanical strain accumulates during magnet cool-down and powering of the coils. In this work, we present a 3D elasto-plastic mechanical model of a single YBCO tape implemented using the free open source FEM library Sparselizard. We present the mechanical analysis of YBCO tape during cool-down, axial, and transverse loading and the resulting stress and strain distribution within the tape layers. The definition of material properties becomes a significant uncertainty in the tape simulation. A sensitivity analysis is performed to quantify the impact of varying the elastic and plastic mechanical material properties of YBCO, copper, Hastelloy, silver, and buffer layer. The results show how sensitive the mechanical stress and strain in the YBCO layer is to the variation of individual material properties.

Category

Mechanical modelling of LTS and HTS magnets

Keywords

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