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Design optimization and fabrication of HTS magnet with stepped cross-section

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Abstract:

High-temperature superconducting (HTS) magnet is a promising candidate for transportation systems and power systems, such as ultra-high field magnet, electrodynamic suspension (EDS) train, magnetic resonance imaging (MRI), due to its large current-carrying capacity and low power loss. The critical current of the HTS magnet depending on magnetic flux density is an essential factor assessing its application performance. Normally, the HTS magnet is wound into rectangular cross-section, which results in magnetic field concentration. By contrast, the HTS magnet with stepped cross-section can alleviate the magnetic field concentration, and improve the critical current accordingly. From this point, this paper will design an HTS magnet with stepped cross-section to maximum the critical current. Firstly, a homogenized self-consistent model is established for assessing the critical current of HTS magnet. Then the geometry parameters of the HTS magnet are designed and optimized with the self-consistent model. Eventually, based on the design results, an HTS magnet with stepped cross-section is wound. The magnetic field distribution and critical current were experimentally measured to verify the calculated results.

Keywords: HTS magnet, stepped cross-section shape, optimization, critical current

Primary authors: LI, Songlin (Southwest Jiaotong University, Chengdu, China); GONG, Tianyong (Southwest Jiaotong University); MA, Guangtong (Southwest Jiaotong University)

Presenter: LI, Songlin (Southwest Jiaotong University, Chengdu, China)

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