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Fri-Mo-Po.02-04: Investigation on Magnetization Characteristics of YBCO Bulk Superconductors in Post-Assembly Magnetization Application

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High-temperature superconducting (HTS) bulks can exhibit superconducting properties at liquid nitrogen temperature. As a type-II superconductor, these materials demonstrate flux pinning effects, wherein magnetic flux is pinned inside the superconductor when the external magnetic field exceeds its lower critical field. This phenomenon imparts permanent magnet characteristics to the material, with remanent magnetization surpassing that of conventional rare-earth permanent magnets. For existing permanent magnet motors, magnetized HTS bulks can replace traditional permanent magnets as the magnetic source. Most current studies on the flux-trapping characteristics of HTS bulks employ the field-cooling (FC) method, wherein a steady magnetic field is applied before cooling the material below its critical temperature. While this approach enables maximum flux capture, it is impractical for HTS bulks mounted on motor rotors in real-world applications. To address this limitation, the pulse field magnetization (PFM) method emerges as a portable and flexible alternative. However, challenges such as non-uniform magnetizing fields during the pulsing process need to be overcome. Limited research exists on the magnetization characteristics of HTS bulks under varying angles and pulse widths of magnetic fields. This study investigates the anisotropic PFM characteristics of YBCO bulk superconductors. An experimental platform was designed to examine the magnetization performance of HTS bulks under magnetic fields with different angles and pulse widths. Magnetization curves of YBCO bulks were measured under various magnetic field intensities, pulse durations, and angles. Finite element numerical simulations were also conducted to validate the experimental results. These findings provide guidance for the application of HTS bulks in high-temperature superconducting permanent magnet motors.

Authors: LI, Rui (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology); LI, Liang (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology)

Presenter: LI, Rui (Wuhan National High Magnetic Field Center, Huazhong University of Science and Technology)

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