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Wed-Af-Or3-05: Modeling and experiment result of double staggered-array helical undulator made of stacked RE-Ba-Cu-O tapes

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High-temperature superconducting (HTS) materials have attracted significant interest for use in insertion devices due to their higher critical temperature, Tc and larger critical current density, Jc compared to low-temperature superconducting wires [1-3]. These properties enable the development of undulators with shorter period and larger on-axis magnetic field. Helical undulators, which suppress higher harmonic photon generation, are particularly well-suited for free electron laser (FEL) facilities that utilize photons at their fundamental wavelength. To facilitate the future upgrade of the Shanghai Soft X-ray Free Electron Laser (SXFEL) facility, we propose the development of a 12 mm-period HTS helical undulator incorporating a double staggered-array configuration based on stacked RE-Ba-Cu-O tapes. Numerical optimization for various configurations of stacked tapes indicates that an on-axis field Bx0 and By0 reaching 1.0 T (with an effective magnetic field, Beff, of 1.4 T) can be achieved using 12 mm-width stacked tapes in a trapezoid configuration, with a period length of 12 mm and a magnetic gap of 6 mm. Based on the optimized configuration, we fabricated an HTS helical undulator model with ten periods at Zhangjiang Laboratory. The short model underwent an initial testing following field-cooled magnetization from 0.3 T to 0 T at 77 K, with subsequent testing conducted using a superconducting solenoid magnet with Bs > 10 T. This study provides a detailed summary of the sample preparation process and the corresponding test results.

Key words: helical undulator, high-temperature superconductor, RE-Ba-Cu-O

References

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