Contribution ID: **101** Type: **Poster**

M2Po2C-02: Development and testing of a few-period, subsize coil for MgB2 Planar Undulator

Tuesday 11 July 2023 14:00 (2 hours)

MgB2 based superconducting planar undulators are of interest for future electron storage rings for synchrotron radiation by virtue of their higher temperature operation margin with higher stability. In this work, an undulator winding consisting of twelve small pancake coils wound with multifilamentary MgB2 strands was fabricated and tested in liquid and gaseous He, from 4.2 K –20 K. The coil had a period of 14.4 mm, and it was 5 mm wide and 4.8 mm thick. A critical current (Ic) of 325.7 A was achieved at 4.2 K, and a maximum field of 1.16 T was measured at 314.2 A (extrapolating to 1.19 T at Ic). Finite element modeling (FEM) was performed and validated by the experimental results. Subsequently, modeling has been extended to a 1-meter-long undulator. The magnetic field was measured as the hall probe was translated along the beam axis with an applied current of 14.8 A. The spatially alternating field was asymmetric, with 0.116 T measured in the positive domain and 0.056 T in the negative domain. The maximum field was larger in the positive direction than the negative; the difference is due to the broken symmetry, i.e., the end effect. Coil measurements at the different temperatures gave an almost flat I-V curve following an inductive voltage offset in the beginning. FEM results for the 1-meter undulator indicated that the field of 1 T can be achieved at 10-15 K operation with some modest further development. Operation in this temperature range allows a larger thermal margin and conduction-cooled operation.

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Session Classification: M2Po2C: Fusion and High Field Magnets