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Sat-Af-Or4-08: Effect of the Filament Diameter Size on the Hysteresis Loss of Nb₃Sn Wires

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Commercially available Nb₃Sn wires with high critical current density are commonly used to manufacture high-field magnets (greater than 10T). To improve their current-carrying capacity, various types of Nb₃Sn wires have been developed. However, as the critical current increases, drawing the Nb₃Sn wire becomes more difficult, leading to larger filament sizes (on the order of hundreds of microns). This can result in flux jumps and high AC losses. Therefore, it is essential to study the impact of filament size on hysteresis loss in Nb₃Sn wires for the effective production of high-field magnets. In this study, we processed various samples with different diameters to produce Nb₃Sn filaments of varying sizes after heat treatment. The hysteresis loops of the Nb₃Sn wire samples were measured at different conditions, and the effect of filament size on flux jumps was investigated to determine the critical filament dimension that avoids flux jumps. Hysteresis loss was calculated from the hysteresis loop data, showing that smaller Nb₃Sn filaments exhibit lower hysteresis losses. However, for micron-level filament samples, reducing filament size becomes increasingly difficult due to filament coupling.

Author: Prof. WU, Bo (State Engineering Lab. of Superconducting Material Preparation and Western Superconducting Technologies Co. Ltd.)

Co-authors: Mr CHEN, Jianya; YAN, Guo; LI, Jianfeng; Mr LI, Zheng; Prof. GUO, Qiang; Dr WANG, Chunguang; Dr XIN, Yang; Prof. ZHANG, Ke; Prof. LIU, Xianghong; Prof. FENG, Yong; Prof. ZHANG, Pingxiang

Presenter: Prof. WU, Bo (State Engineering Lab. of Superconducting Material Preparation and Western Superconducting Technologies Co. Ltd.)

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