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M1Po2B-02 [32]: Vortex pinning changes caused by external mechanical loading of REBCO coated conductor

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In the quest for ultra-high-field magnets, one inevitable challenge is ever larger electromagnetic forces and their effect on the conductor. REBa2Cu3O7-x (REBCO) coated conductors have extraordinary transport and mechanical properties but how the vortex pinning and the external stresses are related is not well understood, especially when it passes the reversible strain of the conductor. This study aims to answer this question and analyze the related challenges for REBCO coated conductors in ultra-high-field magnets. In the experiment, lengthwise Ic and angular Ic (Ic(θ)) of a REBCO tape with artificial pinning centers (APCs) was measured by YateStar in LN2, which is a nondestructive Ic measurement system. After the measurement, 5 pieces of 16 cm long REBCO tapes were cut out and tested under 0.2%, 0.4%, 0.6%, 0.8% and 1.0% strain, respectively. Then all the tested tapes were run through YateStar again. Lastly, small pieces with 4 × 4 mm in size were cut out and measured in SQUID for their critical temperatures (Tc). Magneto-optic imaging (MOI) and SEM were also employed for structural examinations. It was found that the irreversible strain is between 0.6% and 0.8%. The sample strained to 1.0% almost lost all its superconductivity. Ic(θ) at 77 K shows that the featuring peak of BaZrO3 (B∥c) disappears for the sample strained to 0.8%. Magnetization measurements show that all the samples have very similar Tc except the one strained to 1.0%. Its Tc has been lowered by ˜1 K. These results indicate that external stresses can cause permanent vortex pinning changes in the conductor and it occurs before the Tc change. In the quench of superconducting magnets, over-strain of the conductor is possible. This study gives insights of the vortex pinning properties of the conductor even if it is within the reversible strain.

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