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Experimental Study on the Mechanical Stress Effect on the Degradation of High Temperature Superconducting Coils

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High temperature superconducting (HTS) conductors are expected to improve small sized high field magnets. However, the mechanical stresses lower the critical current properties of the HTS tapes. The objective of this work is to clarify the relationship between the critical current properties and the total tensile stresses caused by the winding tension during the coil winding process and the electromagnetic forces during the coil excitation process. As a previous work, the authors carried out the short sample tests using YBCO coated conductors with 0.22 mm of the thickness. From the results, when the YBCO tape is bending with 30 mm of the flatwise curvature radius, over 200 MPa of the applied tensile stress lowers its critical current property. In order to compare the mechanical stress effect of the YBCO coils with the short sample test results, the authors carry out one turn coil tests using YBCO tapes. The one turn coil radius is 30 mm. In order to evaluate the winding tension effect on the critical current, the authors develop a winding machine which can control the winding tension from 0 N to 1 kN. Using a 10-T cryogen free superconducting magnets with 150 mm of the bore diameter, the authors will carry out the excitation tests of the one turn coil with liquid nitrogen cooling and evaluate the hoop stress effect caused by the induced electromagnetic forces. From the one turn coil test results, this paper summarizes the mechanical stress restriction which causes to the degradation of the YBCO coils.

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