

Stress and strain characterizations of REBCO coated conductors for a 25 T cryogen-free superconducting magnet

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A REBCO coated conductor is a useful material for high field superconducting magnets because of the excellent mechanical and superconducting properties. We are developing a 25 T cryogen-free superconducting magnet (25T-CSM) with REBCO insert, Nb₃Sn Rutherford and NbTi Rutherford coils at the HFLSM, IMR, Tohoku University. The REBCO insert coil generates 11.5 T in a 14 T background field of the Nb₃Sn and NbTi coils. The REBCO coil is used in high magnetic field and high electromagnetic stress. We measured the superconducting and mechanical properties for REBCO coated conductors in order to confirm their availability for the 25T-CSM. In this conference, I will report the results of characterizations of the REBCO coated conductors.

The GdBCO coated conductor produced by Fujikura is a copper-plated conductor with a width of 5 mm. The thickness of the Hastelloy and Cu are 0.075 mm and 0.04 mm, respectively.

The mechanical properties of the GdBCO coated conductor were measured up to 5 T and 1 kN at 77 K. We found that the critical current of the GdBCO conductor was not degraded seriously up to about 800 MPa of tensile stress. The result shows that the GdBCO conductor can be used for the insert coil of the 25T-CSM, which is operated under 488 MPa of the electromagnetic stress. Moreover, the critical current of this GdBCO coated conductor has small strain sensitivity. The origin of the strain sensitivity was investigated by the internal strain measurement using X-ray diffraction. The internal strain of the GdBCO was evaluated by the lattice spacing of the GdBCO 110 or 220 peaks. We found that 85% of the applied tensile strain was induced in the GdBCO of the coated conductor. The reduction of the strain may be an origin of the small strain dependence of critical current of the GdBCO coated conductors.