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Coupling time constant measurements of short pieces of copper-plated multifilament coated conductors at 4.2 K and 77 K

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The reduction of large AC losses in ReBCO coated conductors caused by their wide tape shape is a critical issue for their power applications. In principle, striating the wide superconductor layer of a coated conductor into narrow filaments (multifilament) is effective for the AC loss reduction. However, this approach is effective only when the filaments are decoupled electromagnetically, i.e. the coupling current between filaments decays, and, therefore, the experimental determination of their coupling time constants, which is the decay time constant of coupling current, are important. Our previous study suggested that the plated copper governs the transverse resistances between filaments in copper-plated multifilament coated conductors. If so, their coupling time constants could depend on temperature.

We are constructing an experimental setup to measure the frequency-dependent magnetization loss at 4.2 K and 77 K. In this setup, a cryostat, in which a sample is cooled in liquid helium or in liquid nitrogen, is installed in a pick-up coil, with which the magnetization of the sample is measured. The magnetic field whose frequency is from 10 Hz to 20 kHz is applied to the sample by a copper dipole magnet placed outside the pick-up coil. In order to apply wide range of frequency, the cryostat is made of GFRP to eliminate eddy currents affecting magnetic field.

We will measure the frequency dependence of magnetization loss ($Q_m - f$ plot) at 77 K and 4.2 K then fit the measured $Q_m - f$ plot plot to a Debye curve so that we can determine the coupling time constant. Finally, we compare the measured coupling time constant with numerical calculated one to determine the transverse resistance.

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