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Suppression of Flux Creep in HTS Coil by Applying Low AC Magnetic Field

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High temperature superconducting (HTS) wires such as first generation Bi-2223 Ag-sheathed tape and second generation rare-earth-based coated conductor have been developed and become commercially available. When the HTS coils wound using these wires are energized, the in-plane screening currents induced in the windings due to the perpendicular components of locally applied magnetic fields not only slightly decrease the magnitudes of central magnetic fields but also drastically degrade their uniformity. The effective methods to eliminate the screening-current-induced field in the HTS coil have been proposed and validated experimentally. In these methods, cyclic magnetic fields with the amplitudes larger than the full penetration field are applied to the HTS windings using additional coils located around them. The elimination of the screening-current-induced field would enable us to ensure the field homogeneity required especially in future HTS magnet system for nuclear magnetic resonance or magnetic resonance imaging. Furthermore, the temporal stability of the central magnetic field would also be required for their realization. In this study, the suppression of flux creep in the central magnetic field of an HTS coil is experimentally validated by applying a low AC magnetic field using additional coils. The HTS coil is fabricated using a Gd-based coated conductor, and a pair of the additional coils wound using copper wires, which are connected in series in the opposite direction, are located coaxially inside and outside the HTS coil. These coils are immersed in liquid nitrogen, and the time evolutions of the central fields in the axial direction after the excitations of the HTS coil and during the subsequent applications of AC fields with the additional coils are observed using a Hall probe. The influences of the amplitude of AC field, frequency and number of AC cycles on the flux creep in the HTS coil are investigated experimentally.

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