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Wed-Mo-Po.05-08: Fabrication of compact HTS coil for x-ray diffractometer with controllable magnetic field angle

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The no-insulation (NI) technique has been widely used in the development of high temperature superconducting (HTS) magnets. The compact 23 T NI-HTS magnet consists of pocket-sized double pancake coils was developed and reported. Therefore, it has been demonstrated that NI HTS coils are suitable not only for large-scale, high-field applications but also for small-scale, high-field applications. On the other hand, X-ray diffractometers using cryocooler are very useful instruments for identifying materials and determining crystal structures of crystalline samples. In the study of the crystal and electronic structures of materials using an X-ray diffractometer, physical properties are measured while varying external conditions such as temperature, pressure, and magnetic field. Although permanent magnets are used in X-ray diffractometers to apply magnetic fields, permanent magnets cannot change the magnetic field. While a normal electromagnet can change the magnetic field strength, the magnetic field strength is very low and generates heat due to the energizing current. In addition, a problem with current X-ray diffractometers is that the space needed to install a magnet is limited. In this study, we fabricated a compact HTS coil for X-ray diffractometer that can be installed in a narrow space (cylindrical space 50mm in diameter and 50mm in height). We proposed the NI HTS coil that can control not only the strength of the applied magnetic field but also the angle of the magnetic field. The target magnetic field strength applied to the sample crystal is 0.5 T, and the variable angle of the magnetic field is 45 degrees. Two Helmholtz-shaped HTS coils wound with REBCO wire on the top and bottom of a copper bobbin (ID and OD are 15 and 19 mm) were prepared. The number of turns in each coil is 100, and the two Helmholtz-shaped HTS coils are crossed at right angles. The direction of the magnetic flux applied to the sample crystal is changed by the magnetic field from the HTS sub coil assembled perpendicular to the HTS main coil. The magnetic field performance of the fabricated HTS coil was measured in liquid nitrogen and under conduction cooling, and the experimental results will be presented.

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