§14. Magnetic Field Characteristics on the Joint of the Prototype NbTi Cable-in-conduit Conductor for JT-60 EF Coil

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Superconducting fusion magnets have many joint regions which have a great influence on the performance of the magnets. Various joint types for the magnets were developed before now to reduce AC loss and electrical resistance. However, electrical phenomena in the joint region are not understood very well. In this study, magnetic field measurements on a shake-hands lap joint were conducted for the purpose of understanding magnetic field characteristics of the joint region. A shake-hands lap joint sample of cable-in-conduit conductors for JT-60SA EF coil was utilized in the field measurement. Fig.1 shows the picture of the joint sample. Each conductor consists of NbTi strands and is equipped with a central spiral channel. The cross section of the joint sample is illustrated in Fig.2. In the joint region, a saddle spacer of oxygen-free copper is located between the conductors removing Ni plating. The spacer and the conductors are electrically connected with solder and are clamped with SUS316L. Hall proves are lined up in the center of the joint region parallel to the conductors. By using the hall proves, vertical magnetic fields to the joint region were able to be measured in various DC excitation. Fig.3 shows the result of the magnetic field measurement. As the sample current increases, the magnetic field distribution spreads symmetrically on the basis of the hall prove H5 which is located at the center of the joint region. The vertical magnetic field keeps 0 T at the hall prove H5 under the excitation of the joint sample. Consequently, the current distribution would be uniform at the saddle shape spacer between the conductors.

As shown in Fig.3, the magnetic fields decrease with a decay time constant after the sample current is held. After the sample current is shut down, the joint region keeps the magnetic field. The cause of the phenomena would be coupling current in the cable-in-conduit conductors. The decay time is about 120 sec.

In order to understand the current distribution in the joint region, the analysis of the current distribution is going to be conducted by using a simple analysis model with line current..

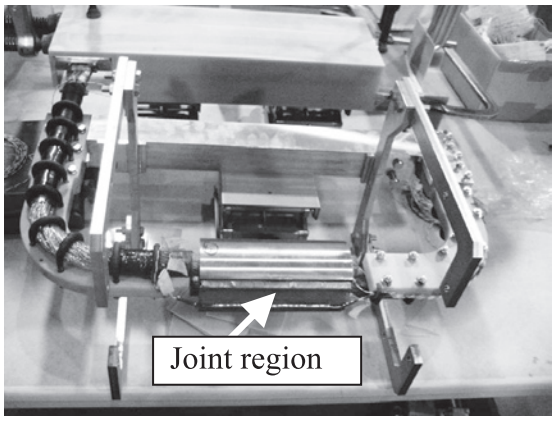

Fig. 1. Joint sample of CIC conductors for JT-60SA EF coil.

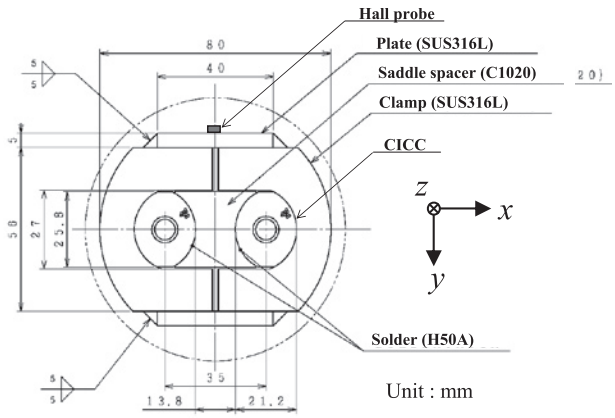

Fig. 2. Cross-section of the joint sample.

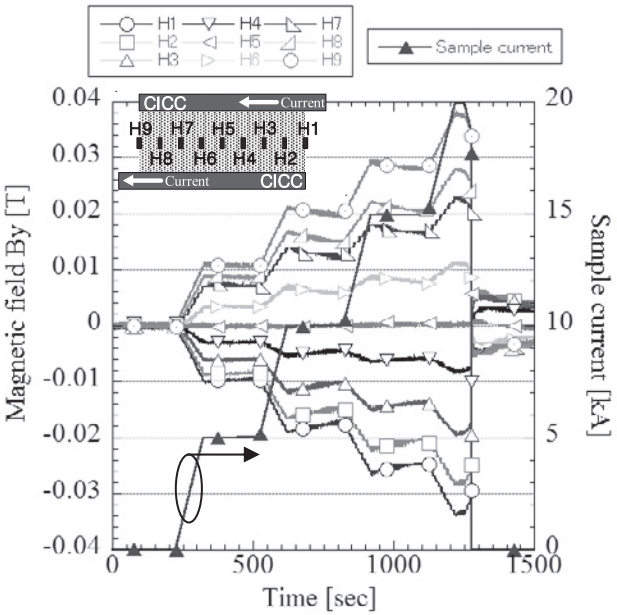

Fig. 3. Measurement results of self-magnetic field at the joint region field.