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Current status of LTS and HTS wires for high field applications

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Satoshi Awaji
High Field Laboratory for Superconducting Materials, Institute for Materials Research, Tohoku University

Practical Nb3Sn wires are still under improvement for high field applications such as accelerator, nuclear fusion, NMR and so on. Recently, the increase of non-Cu Jc are required for the future circular collider (FCC). In addition, the strengthening of the Nb3Sn wires have been developed. In particular, high strength Nb3Sn wires enable the compact high field superconducting magnets with a react-and-wind (R&W). We have successfully developed low temperature superconducting (LTS) magnets for the 25T- and 33T- cryogen-free superconducting magnets (CSMs) with the high strength Nb3Sn and NbTi Rutherford cables. The maximum hoop stresses are 250 MPa and 275 MP for the 14T-LTS magnets of the 25T-CSM and the 33T-CSM, respectively. In particular, the 25T-CSM has been in operation for 10 years without any problems in the LTS magnets under the high stresses.
The REBa2Cu3Oy (REBCO, RE: rare earth and Y), Bi2Sr2Ca2Cu3Oy (Bi2223) and Bi2Sr2CaCu2Oy (Bi2212) are practically available as the high temperature superconducting (HTS) wires/tapes, although the Sumitomo Electrical Industry (SEI) Co ltd. recently stopped the production of Bi2223 tapes unfortunately. The high strength Bi2223 tapes (SEI HT-Nx) were used for the 25T-CSM with the maximum hoop stress of 318 MPa. The 19T REBCO insert magnet is under construction for the 33T-CSM. The REBCO tapes have very high in-field Jc and strong mechanical tensile stress performance, although it depends on tape architectures such as thickness of Cu stabilizer and Hastelloy substrates. In addition, the artificial pinning centers (APC) such as nanorods and nanoparticles are introduced in practical REBCO tapes. It improves not only the in-field Jc but also its anisotropy. On the other hands, there are some serious issues such as delamination, slit edge, screening currents, which should be overcome.
The present status of practical LTS and HTS wires will be presented from the view point of high field applications with some recent developments of cryogen-free superconducting magnets.

Country or International Organisation

Affiliation

Speaker's email address

Presenter: AWAJI, Satoshi (Tohoku University)

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