National Projects on Superconducting Wires and their Applications in Japan

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***Abstract*— In this presentation, I will briefly introduce recent national projects that aim at high performance superconducting wires and their applications.**

I. Japan Science and Technology Agency (JST) started JST-MIRAI project "Social implementation of super-high field NMRs and DC superconducting cables for railway systems, through advancement of joint-technology between high temperature superconducting wires (Project Leader, H. Maeda)" [1]. This project consists of two R&D items, (a) development of superconducting-joints (10^{-13} Ω) between HTS conductors, which are installed in the world's highest field persistent current mode 1.3 GHz (30.5 T) NMR; the joining performance is evaluated based on NMR spectra: (b) development of ultra-low resistive joints(10^{-9} Ω) between DC superconducting feeder cables for railway systems. Recently, they have succeeded in generating 30T with the configuration of RE-123 inner coil, BSCCO middle coil and conventional metallic outer coil. This is a big step towards 1.3 GHz NMR.

II. JST is now operating seven superconductor projects in Advanced Low Carbon Technology Research and Development (ALCA) Programs) [2]. One of them is "Low-Cost High Temperature Superconducting Wire (Leader: T. Doi, Kyoto Univ.)". Because the present price of superconducting wires is very expensive, they are used only for special purpose such as MRI and MGLEV. In this research, for realizing one tenth of the current price, they try to develop a new low-cost superconducting wire which does not use either expensive noble metal, rare earth or rare metal, and to develop inexpensive manufacturing process suitable for the low- cost superconducting wire. Recently, they have fabricated high J_c REBCO tapes using stainless steel/Cu substrate tapes. NIMS-Hitachi-Kyushu Univ. group is engaged in other superconducting wire program "High performance long length MgB_2 wires". The program consists of fabrication of 100m-km long MgB_2 wires with PIT and IMD methods, evaluation of these wires by scanning Hall probe microscopy and X-ray micro-computer-tomography. Recently, they fabricated 1.2km-long high-J_c PIT-processed MgB_2 wire applying mechanical milling process.

III. New Energy and Industrial Technology Development Organization (NEDO) has identified four technology development areas to promote commercialization of high temperature superconductivity (HTS) in May 2016 (Leader, M. Okada) [3]. In the field of electric power, the development focuses on ensuring essential safety functions for the practical use of superconductivity cable systems as well as establishing recovery methods in the event an accident or malfunction occurs. In the field of transportation, demonstration of superconductivity DC power transmission technology is conducted. Standards for design and construction methods as well as system operation and maintenance are established. Finally, the field of industrial technology covers the technology development of high stable

HTS magnet system for applications in MRI, as well as the technology development of HTS wire to improve the magnetic field characteristics and to reduce the cost with the aim of promoting rapid commercialization.

References

[1] https://www.jst.go.jp/mirai/jp/program/large-scale-type/index.html#theme02
[2] https://www.jst.go.jp/alca/en/kadai.html
[3] https://www.nedo.go.jp/english/news/AA5en_100071.html

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