(2) Applied Superconductivity and Cryogenics

1. Introduction

From the viewpoint of the efficiency of an energy source, adoption of superconducting systems is essential for fusion power plants. Therefore, the progress of superconducting technology is indispensable to construct the next fusion experimental device for the magnetic confinement of plasma. Research activities related to applied superconductivity and cryogenics are summarized in this section. The research subjects using the superconducting system of LHD are summarized in Section 1-1-(4) 'LHD Device Engineering Experiments'. The research subjects concerning design studies of advanced superconducting systems for a helical reactor are summarized in Section 2-(2) 'Helical Reactor Design'. In addition, the research subjects of the LHD Project Research Collaboration are summarized in Section 1-5.

2. Research activities of collaboration

We have promoted research collaboration on applied superconducting technology and cryogenic engineering. It includes basic and applied studies. The purpose of these research activities is early realization of a fusion reactor and application of developed technologies to other areas. Various research collaborations have been carried out, such as basic study on electromagnetic properties of High Temperature Superconductor (HTS), a new Nb_3Sn conductor with the Jelly Roll process, reliability of cryogenic electrical insulation, stability analyses of the conduction cooled coil, next generation power devices, an advanced concept of CIC conductors, YBCO tape conductors for a fusion reactor, mechanical properties of HTS bulks, heat transfer characteristics of liquid hydrogen, and investigation of regenerator of a pulse tube current lead. The titles of the researches are listed in the following.

(1) Basic Study on the Electromagnetic Properties of Oxide Superconductors for Nuclear Fusion Reactor. (Iwakuma, M. (Kyushu Univ.))
(2) Development of New High Field and High Current Density Superconductors for Fusion Devises. (Tachikawa, K. (Tokai Univ.))
(3) Establishment of Partial Discharge Protection Technology for Reliability Improvement of Electrical Insulation of LHD. (Nagao, M. (Toyohashi Univ. of Tech.))
(4) Stability Analysis of a Curved Saddle Shaped Superconducting Coil with Conduction Cooling. (Obana, T. (NIFS), Ogitsu, T. (KEK))
(5) Study on Application of Next Generation Power Devices for the Fusion System. (Ise. T. (Osaka Univ.))
(6) Investigation of Advanced Superconducting Cable-in-Conduit Conductor. (Hamajima, T. (Tohoku Univ.))
(7) Superconducting Current Leads Prepared by the YBCO Tapes. (Yamada, Y. (Tokai Univ.))
(8) Study on Improvement of the Mechanical Properties of HTS Bulks by Reducing Pores. (Murakami, A. (Hirosaki Univ.))
(9) Heat Transfer Characteristics of Liquid Hydrogen for Superconducting devices. (Shirai, Y. (Kyoto Univ.))
(10) Regenerator Performance Investigations for the Pulse Tube Current Lead. (Masuyama, S. (Oshima National College Maritime Technol.))

3. Research activities of the applied superconductivity group of NIFS

The applied superconductivity group is belonging to the Fusion & Advanced Technology Systems Division of the Department of Large Helical Device Project. The group is pursuing not only the establishment of operation of LHD superconducting system but also rigorous researches to improve its performance. Furthermore, we focus on the design study of a helical fusion reactor and on the development of its superconducting technology. Our research activities are listed below.

(11) Critical Currents of Aluminum-Alloy Jacketed Nb3Sn Superconductor Fabricated by React-and-Jacket Process. (Takahata, K. (NIFS))
(12) Study of the Current Distribution in the Joint of the Prototype NbTi Cable-in-conduit Conductor for JT-60 EF Coil. (Obana, T. (NIFS))
(13) Conceptual Design of 10 kA Class MgB2 Cable for Hybrid Energy Transfer Line. (Yamada, S. (NIFS))
(14) Experiments of Bending Strain on Reduced-Scale YBCO Conductors for Fusion Energy Magnets. (Yanagi, N. (NIFS))
(15) Novel Approach to Form a Hydrogen Ice Layer for the FIREX Cryogenic Target. (Iwamoto, A. (NIFS))
(16) Development of Highly Effective Cooling Technology for a Superconducting Magnet using Cryogenic OHP. (Mito, T. (NIFS))

(Imagawa, S.)