2-2. Applied Superconductivity Systems

1. Introduction

Advanced technologies in superconducting systems are essential 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 2-1 'Helical Reactor Design'. In addition, the research subjects of the LHD Project Research Collaboration are summarized in Section 1-4.

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 a Nb_3Sn conductor with a new diffusion process, reliability of cryogenic electrical insulation, an advanced concept of CIC (Cable in Conduit) conductors, basic study on properties of High Temperature Superconductor (HTS), next generation power devices, properties of liquid helium, development of V_3Ga superconducting wires, irradiation effects, mechanical tests at low temperatures, and so on. The titles of the researches are listed in the following.

(1) Synthesis of High Performance Nb_3Sn Layers through the New Diffusion Process. (Tachikawa, K. (Tokai Univ.))
(2) Establishment of Partial Discharge Protection Technology for Reliability Improvement on Electrical Insulation of LHD. (Nagao, M. (Toyohashi Univ. of Tech.))
(3) Investigation of Advanced Superconducting Cable-in-Conduit Conductor. (Hamajima, T. (Tohoku Univ.))
(4) Superconducting Current Leads Prepared by the YBCO tapes. (Yamada, Y. (Tokai Univ.))
(5) Study on Improvement of the Mechanical Properties of HTS Bulks by Reducing Pores. (Murakami, A. (Hirosaki Univ.))
(6) Regenerator Performance Investigations for the Pulse Tube Current Lead. (Masuyama, S. (Oshima National College Maritime Technol.))
(7) Basic Study on The AC Loss Reduction of Oxide Superconductors for Nuclear Fusion Reactor (Iwakuma, M. (Kyushu Univ.))
(8) Power Supply System for Nuclear Fusion Plant Using DC Power Distribution (Ise. T. (Osaka Univ.))
(9) Study on Turbulent Control of Supercritical Helium in Cooling Channel for Superconducting Magnet System (Okamura, T. (KEK))
(10) Development of A Conductor with Large Capacity for Fusion Devices by Using Superconducting Tapes with High Aspect Ratio of Cross-section. (Sumiyoshi, F. (Kagoshima Univ.))
(11) Conceptual Design of Advanced Superconducting Magnet with Aluminum Stabilized Nb_3Al Conductor for FFHR. (Nakamoto, T. (KEK))
(12) On the Measurement Technique of Velocity Fluctuation in Super Fluid He II. (Tsuji, Y., Nagoya Univ.))
(13) Development of V_3Ga Superconducting Wires by Using V-Ga and Ti-Ga Compound as High Ga Source Material. (Kikuchi, A. (NIMS))
(14) Radiation Effects of Organic Electric Insulation Materials. (Akiyama, Y. (Osaka Univ.))
(15) Flux Pinning Properties of Defects Nucleated by Neutron Irradiation in A15 Type Superconductor A Combined NIFS System. (Kiuchi, M. (Kyutech Univ.))
(16) Investigation of The Cross-sectional Configuration of Ag Sheath Material for High Strength Bi-2212 Superconducting Wire. (Yamada, Y. (Tokai Univ.))
(17) Development of The R Curve Fracture Toughness Test of Round Bar with Circumferential Notch by Using Hardening Curves of Each Virtual Crack Length. (Kasaba, K. (Univ. Toyama))
(18) Cooling Owing to High Thermal Conduction Non-metallic Material and Stability of Superconducting coil. (Takao, T. (Sophia Univ.))
(19) Cryogenic Mixed-Mode Fatigue Delamination Growth of Composite Insulation Systems for Superconducting Magnets. (Shindo, Y. (Tohoku Univ.))

3. Research activities in NIFS

Research activities on applied superconductivity systems in NIFS focus on the development of advanced superconducting technology for a helical fusion reactor. Their research activities are listed below.

(20) Achievement of High Heat Removal Characteristics of Superconducting Magnets with Imbedded Oscillating Heat Pipes. (Mito, T. (NIFS))
(21) Neutron Irradiation Effect on Superconductivities of Nb_3Sn and Nb_3Al Strands. (Nishimura, A. (NIFS))
(22) Critical Current of React-and-Jacket Processed Nb_3Sn Conductor. (Takahata, K. (NIFS))
(23) Investigation of The Phase Transition in V_3Ga PIT Wires Using High Ga Content Cu-Ga Compounds. (Hishinuma, Y. (NIFS))
(24) Measurements of Self Magnetic Field on NbTi Cable-in-conduit Conductors near the Shake-hands Lap Joint (Obana, T. (NIFS))
(25) Design Study of a 15 T Test Facility for High-Current Superconductors. (Imagawa, S. (NIFS))

(Imagawa, S.)