1. Introduction

The superconducting technology is indispensable to construct a large-scale fusion experimental device for the magnetic confinement of plasma, because steady-state plasma experiments are required for the next step. From the view point of the efficiency of an energy source, adoption of superconducting systems is essential for fusion power plants. 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'. Also, 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 applications of High Temperature Superconductor (HTS) for a current lead and magnetic levitation, mechanical properties of HTS bulks, MgB_2 conductors for a fusion reactor, a new Nb_3Sn conductor with the Jelly Roll process, strand trajectories in a CIC conductor, analyses of the normal zone propagation, reliability of cryogenic electrical insulation, advanced power systems, and stability analyses. 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) Magnetic levitation of miniature-sized spherical-shaped RE123 bulk superconductors. (Tsuda, M. (Tohoku Univ.))
(3) Evaluation of the mechanical properties of HTS single-grain bulks by indentation. (Murakami, A. (Hirosaki Univ.))
(4) MgB_2 superconducting thin wires for current lead application. (Yamada, Y. (Tokai Univ.))
(5) Development of new high field and high current density superconductors for fusion devices. (Tachikawa, K. (Tokai Univ.))
(6) 3-dimensional measurement of the strand trajectories in a large CIC conductor. (Hamajima, T. (Tohoku Univ.))
(7) Effect of disturbance duration on the normal zone propagation of the LHD helical coil. (Shirai, Y. (Kyoto Univ.))
(8) Establishment of partial discharge protection technology for reliability improvement of electrical insulation of LHD. (Nagao, M. (Toyohashi Univ. of Tech.))
(9) Study on application of next generation power devices for the fusion system. (Ise. T. (Osaka Univ.))
(10) Stability Analysis of a curved saddle shaped superconducting coil with conduction cooling. (Obana, T. (NIFS), Ogitsu, T. (KEK))

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) Development of fast ignition target. (Norimatsu, T. (ILE, Osaka Univ.))
(12) Temperature control in the FIREX cryogenic target. (Iwamoto, A. (NIFS))
(13) Adaptation of advanced control to the helium liquefier with C-PREST. (Maekawa, R. (NIFS))
(14) Magnetic field characteristics on the joint of the prototype NbTi cable-in-conduit conductor for JT-60 EF coil. (Obana, T. (NIFS))
(15) Design study of the superconducting split coil based on the $\cos\theta$ current distribution. (Obana, T. (NIFS))
(16) Experiments of bending strain on reduced-scale YBCO conductors for fusion energy magnets. (Yanagi, N. (NIFS))

(Imagawa, S.)