【Grant-in-Aid for Scientific Research (S)】

Broad Section D

Title of Project : Magnet technology development for 50T cryogen-free high temperature superconducting magnet

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Keyword : high temperature superconductors, superconducting magnet

【Purpose and Background of the Research】

More than 30 years past since the high temperature cuprate superconductor was discovered in 1986. Practical high temperature superconducting (HTS) wires are commercialized. Nowadays, many efforts are made for the development of HTS applications. In particular, high field magnets beyond 20 T using HTS are expected, because of those high performances in high magnetic field. However, it is difficult to realize a practical HTS high field magnet, since the magnet design concept for the HTS is much different with that of low temperature superconductor (LTS).

On the other hand, a cryogen-free superconducting magnet (CSM), which is cooled by cryocoolers conductively, is used widely. We recently developed a 25T-CSM with a HTS insert and achieved 24.6 T in a 52 room temperature bore.

In this study, we develop a new HTS magnet technology on the basis of the 25T-CSM, targeting a 50 T-class superconducting magnet. The world record of CSM will be broken by our obtained result.

【Research Methods】

We set four subjects as the HTS magnet technologies in order to generate a stable high magnetic field as follows.

1. Conduction-cooled coil fabrication technology without degradation
2. To understand a mechanical reinforcement and a deformation under a huge electro-magnetic stress
3. To understand a quench behavior and its protection
4. Ac-losses and field induced by the shielding current and coupling windings.

【Expected Research Achievements and Scientific Significance】

By a construction of new magnet technology model for high field HTS magnets, a route to 50 T-class superconducting magnet will be obtained. The world trend of high magnetic field is to achieve more than 40 T using a large electric power above 20 MW. However, we aim for corresponding high magnetic fields using the HTS magnet technologies obtained in this study. The stable and high precise high magnetic fields due to the superconducting magnet gives us new high magnetic field science. In addition, the HTS magnet technology impacts on various practical superconducting applications.

【Publications Relevant to the Project】

- S. Awaji et al., " First performance test of a 25 T cryogen-free superconducting magnet", Supercond. Sci. Technol. 30 (2017) 065001.
- S. Awaji et al., "10T generation by an epoxy impregnated GdBCO insert coil for the 25T-cryogen-free superconducting magnet" , Suprerocnd. Sci. Technol., 29 (2016) 055010.

【Term of Project】 FY2018-2021

【Budget Allocation】 146,100 Thousand Yen

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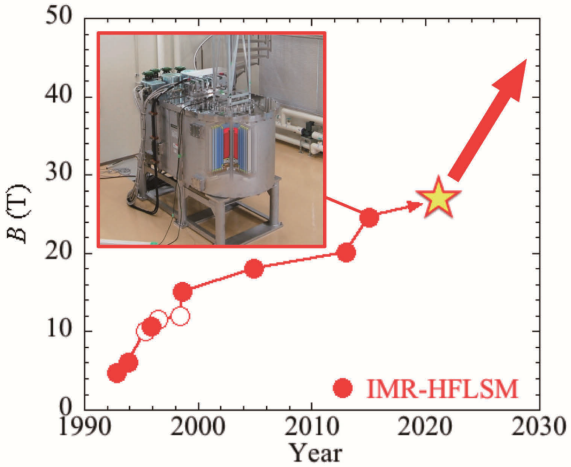

Fig. 1 Progress of cryogen-free superconducting magnet and project target.