IEEE-CSC, ESAS and CSSJ SUPERCONDUCTIVITY NEWS FORUM (global edition), Issue No. 59, May 2025

HTS Fusion Technology Status in China

Jinxing Zheng

Institute of Plasma Physics, Chinese Academy of Sciences

E-mail: jxzheng@ipp.ac.cn

***Abstract*—Due to their higher critical current and lower cooling cost, HTS magnets are being increasingly adopted in fusion devices. HTS magnets can realize 20 T level high magnetic field, a crucial factor for controlling the high temperature plasma and enhancing fusion power. Extensive research on HTS fusion is underway at various institutions and companies, which are aiming for validating the performance of HTS magnet under fusion operating conditions.**

Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP) is now focusing on the large-scale hybrid superconducting central solenoid coil for the new-generation compact fusion device, capable of achieving a 19.6 T magnetic field in the inner HTS magnet, which is wound with HTS CICC conductor with an operating current of 46.5 kA. It can generate about 55 voltage-second to realize easier plasma discharge. To realize higher current capacity and improve preparation process of HTS conductor, ASIPP is currently developing the new TMCC conductor, which simplifies the preparation process by removing the need for soldering and twisting. TMCC conductor can realize better anisotropic properties and suppress the AC loss during fast current ramping rate, which is capable of achieving 50 kA@20T, 4.2 K. Based on TMCC conductor, ASIPP is working on the new HTS fusion magnet. Considering the critical performance degradation of HTS magnet under fusion D-T discharge irradiation conditions, ASIPP has carried out a series of pioneering research work on the damage formation mechanism and critical characteristics evolution process of HTS materials, and scaling-law of REBCO under stress and irradiation has been corrected. It has laid a theoretical foundation for the development and safe operation of large-scale HTS fusion magnets for fusion reactors.

In the research of small-scale HTS fusion devices, Energy Singularity Company in China has designed the world's first full HTS tokamak-HH70 (6.8 m height, 3.6 m outer diameter, 1 T toroidal magnetic field @ R=0.7m). It has successfully achieved its plasma discharge in 2024. The Startorus Fusion, based in Xi'an, China, is cooperating with Tsinghua University on the development of a full-HTS Spherical tokamak device. They achieved first plasma based on the SUNIST-2. Currently, they are working on the world's first Negative Magnetic Spherical

Tokamak (NTST), characterized by a 1 T magnetic field and a plasma center radius of 0.4 m radius at plasma center. Meanwhile, the R&D work on 3 T D-shaped TF magnets is also in progress.

***Keywords (Index Terms)*—AC losses, Coated Conductors, Irradiation, Stability, Tokamak**

IEEE-CSC, ESAS and CSSJ SUPERCONDUCTIVITY NEWS FORUM (global edition), Issue No. 59, May 2025. Presentation given at CCA 2025, March 11-13, 2025, Geneva, Switzerland.