

Mini-RTにおけるイットリウム系超伝導コイルの製作 Fabrication of Yttrium-based Superconducting Coil in the Mini-RT

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Plasma confinement experiment has been conducted with Mini-RT, which has high temperature superconducting(HTS) floating coil made of Bi2223 tape. Now we are fabricating a new HTS coil with a next-generation REBCO tape, which is called Mini-RT/Y, so as to improve the performance of the floating coil, and to establish a fabrication technique of REBCO coil for fusion reactor development.

The technology of REBCO coil has some challenges. One of those challenging issues is a generation of a hot spot at the quench phenomenon, because of a poor heat conductivity and vulnerability to peeling for the REBCO tape. The heat treatment of the hot spot during the quench is important to prevent damage to the coil. As a countermeasure for preventing hot spots in the windings, we have pasted the 0.1mm thick copper to REBCO tape, to suppress the temperature rise when the wire rod transits to normal conducting. Furthermore, in the persistent current operation mode, when a part of winding in the coil transits to normal conducting. It is necessary to suppress the occurrence of hot spots in the normal conducting part which is propagated extensively, the coil current is attenuated rapidly by the increasing coil resistance. With the aim of improving the heat conductivity of the coil, we have sandwiched pure aluminum sheet between the coil winding and the coil frame, and designed to prevent local concentration of heat and non-uniformity of temperature rise.

In addition, we designed the PCS coil with a REBCO tape. In the current PCS of the Mini-RT, since manganese wire heater is wound between the coil and the frame, one side of the PCS is heated, resulting in the non-uniform temperature rise. In order to improve the ON-OFF property of PCS, a sheet-like heater made of SUS304 was introduced so as to improve the uniform heating of PCS. The PCS and heater are co-wound in the Mini-RT/Y, and it has been improved so that the uniform temperature rise. To improve the cooling of the experiment, cooling channel was also changed. The cooling pipe of the PCS in the current Mini-RT is attached only to the top, However, that of the Mini-RT/Y is attached to the top and bottom, improved cooling capacity.

A typical characteristics of Mini-RT/Y is listed in Table I, in comparison with the present Mini-RT.

Table1. Specifications Table

	Mini-RT/B	Mini-RT/Y
Wire Rod	Bi-2223	YBCO
Length	420m	575m
Number of Turns	428	595
Operating Current	100A	100A
Magnetomotive Force	42.8kA	59.5kA
Wire Width	4.32mm	4.3mm
Wire Thickness	0.26mm	0.2mm
Inductance	0.087H	0.165H
Stored Energy	436J	825J
Operating Temperature	20-40K	20-40K