Thermal Strain in Superconducting Nb_3Sn Strand at Cryogenic Temperature

S. Harjo[1#], T. Kawasaki[1], T. Hemmi[2], T. Nakamoto[3] and K. Aizawa[1]

[1] *J-PARC Center, JAEA, Tokai, Ibaraki 319-1195, Japan*
[2] *Fusion Res. Dev. Directorate, JAEA, Naka, Ibaraki 311-0193, Japan*
[3] *Cryogenics Science Center, KEK, Tsukuba, Ibaraki 305-0047, Japan*

 # a corresponding author: stefanus.harjo@j-parc.jp

Large superconducting cables consisting of Nb_3Sn strands are essential components of the experimental fusion reactor built under the ITER project. [1] The presence of strains in the Nb_3Sn is well known to affect superconducting properties [2], and therefore thermal strains at its use conditions (cryogenic temperatures) are necessary to be determined.

Measurements of thermal strains in the superconducting constituent (Nb_3Sn phase) in Nb_3Sn strand were performed using BL19 Takumi of MLF, J-PARC. Lattice parameters of Nb_3Sn phase in Fig. 1(a) change continuously with increasing temperature. To avoid the thermal expansion effect, lattice parameters of the filaments (extracted from the strand) measured at the same temperatures were used to estimate the thermal strains in Nb_3Sn phase. As shown in Fig. 1(b), thermal strains for axial direction below 50 K are kept roughly constant at large compressive values, while the values are much lower (the difference is ~0.13%) than that measured at room temperature [3].

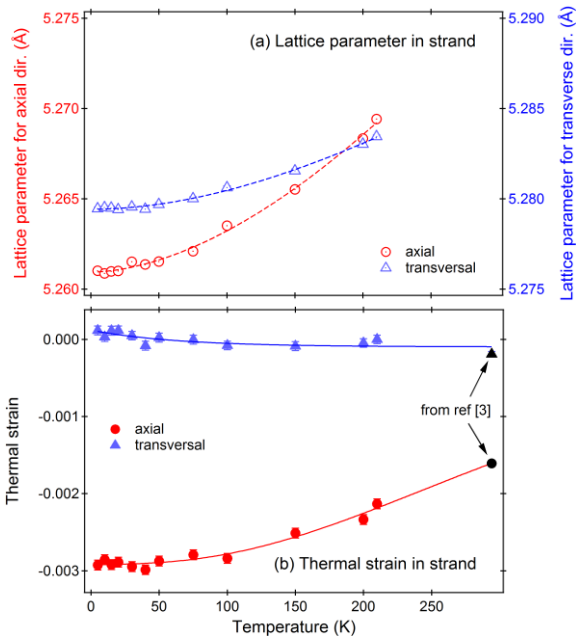

Fig. 1 Changes of (a) lattice parameters and (b) thermal strains of Nb_3Sn phase in the strand with changing temperature.

References

[1] M. Huguet, ITER Joint Central Team, ITER Home Teams, Nucl. Fusion **41**, 1503 (2001).
[2] J.W. Ekin, Cryogenics **20**, 611(1980).
[3] S. Harjo, T. Hemmi, J. Abe, W. Gong, Y. Nunoya, K. Aizawa, T. Ito, N. Koizumi, S. Machiya and K. Osamura, Mater. Sci. Forum **777**, 84 (2014).