§12. Study on the Effect of Transversal Compressive Stress on Superconductors

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i) Introduction

Large electromagnetic force is applied to superconductors in large-scale superconducting coils such as Helical Coils in LHD. We have experimentally studied influence of large-compressive stress applied to the conductors on stability of the conductors.[1)]

ii) Experimental Setup

The experimental arrangement is schematically illustrated in Fig. 1. As shown in the figure, the superconductor (diameter = 1.0 mm, copper ratio = 0.9) is clamped and compressed by the spacers made of FRP. A normal part of the conductor is generated by a heater put on the conductor. Compressive stress and deformation of the conductor are measured by a load cell and a clip gauge respectively.

iii) Experimental Results

Firstly, we measured the characteristic of the compressive force vs. the deformation of the conductor. The result is shown in Fig. 2. From the figure, a yield force of the conductor was between 500 and 550 (N).

Next, we measured propagation velocity of a normal zone of the conductor based on signals from voltage taps on the conductor. The measured part are the compressive segment and before/after the compressive segment. The estimated propagation velocity of the normal zone is shown in Fig. 3. As shown in the figure, the velocity at the compressive segment of the conductor strongly increased when the compressive force was more than 500 - 550 (N).

iv) Concluding Remarks

Based on the propagation velocity of the normal zone we have experimentally studied the stability of the superconductor against the compressive stress to the conductor. When the compressive stress was less than the yield stress, the velocity was almost constant, and hence no degradation of the conductor occurred in the range of the compressive stress.

Reference

1) Takao, T. et al., Degradation of superconductors due to transversal compressive stress, 59th Meeting on Cryogenics and Superconductivity, D2-10 (1998, in Japanese).

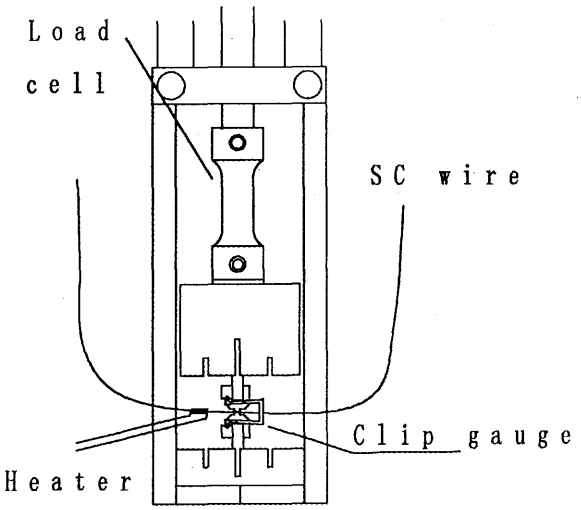

Fig. 1: Experimental arrangement.

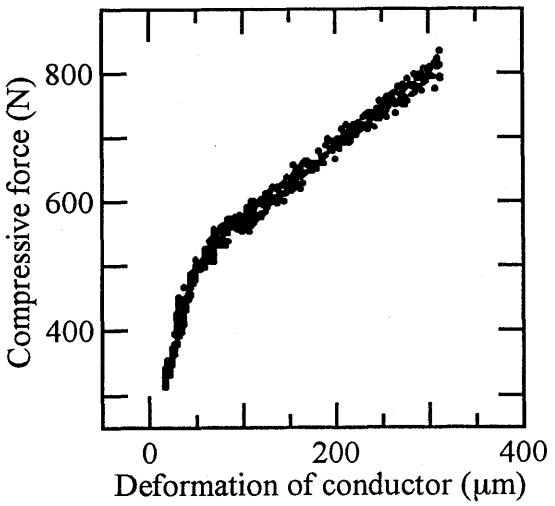

Fig. 2: Deformation of conductor due to transversal compressive force.

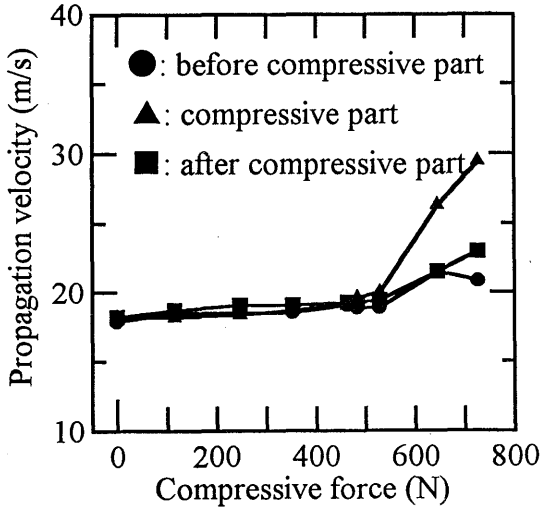

Fig. 3: Propagation velocity of normal zone .