# §25. Neutron Irradiation Effect on Superconducting Magnet Materials for Fusion

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Investigations of neutron irradiation effects on superconducting strands are really important for a design and a construction of a fusion device and a reactor. To obtain the experimental data, 15.5 T superconducting magnet and a variable temperature insert (VTI) have been installed at radiation control area in Oarai center in Tohoku University. The improvement of the test system continues. In 2012, the temperature distribution during applying current was measured at several conditions.

Figure 1 shows the front face of the sample holder. Positive and negative electrodes were fixed with screws and AA and CU type CERNOX sensors were attached. Figure 2 show the back side of the sample holder. A sample of $Nb_3Sn$ strand (non-irradiated) was prepared and SD type sensor was fastened on the sample. The CU and AA sensors at the same electrode showed the same temperature trend.

The result of the current test under 2 T and the ramp rate of 500 A/50 s is shown in Fig. 3. The temperature of positive electrode is higher than others. When the current reached at 427 A, the temperature of the positive electrode rose up to over 12.5 K, while the temperature of the sample showed about 8 K. When the ramp rate was reduced to 500 A/600 s, the difference in the temperature became clearer as shown in Fig.4. The last current was degraded to 405 A and the temperatures of positive and negative electrodes and the sample were reached to over 13 K, about 9.5 K and about 7.5 K respectively.

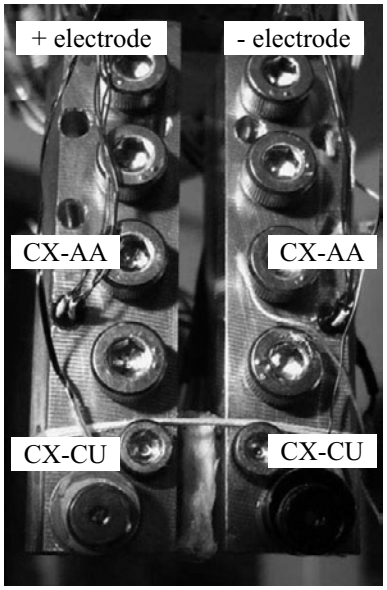


Fig. 1. Set up of the sample holder. Four CERNOX censers were attached.

Since the critical temperature at the self-field (0 T) of the strand is expected around 13 K, the sample on the positive electrode would become non-super resulting in generating a large voltage. The sample temperature also increased more than in the case of 500 A/50 s.

At present, it is hard to determine the critical current at a certain temperature. The system will be tested again and the heat transfer with a pure aluminum will be evaluated. If the enough heat flow on the interface of the heat rod and the electrode is confirmed, the reason of the larger temperature rise will be discussed.

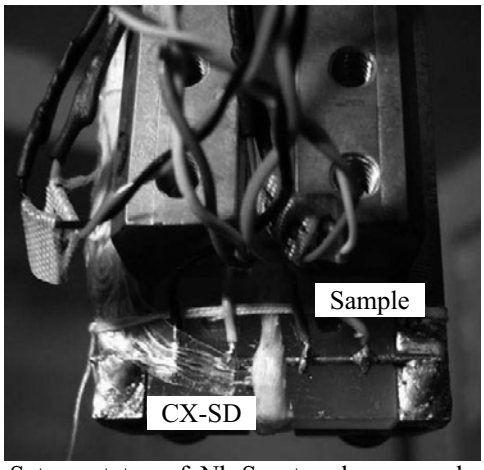


Fig. 2. Set-up status of $Nb_3Sn$ strand on sample holder. CX-SD was attached on the sample.

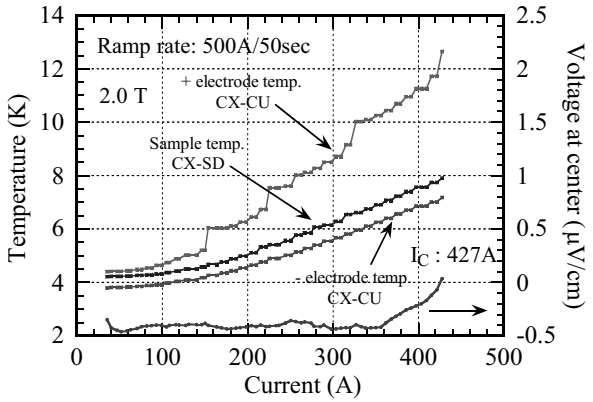


Fig. 3. Test results of $Nb_3Sn$ strand under 2.0 T. Ramp rate was 500A/50sec.

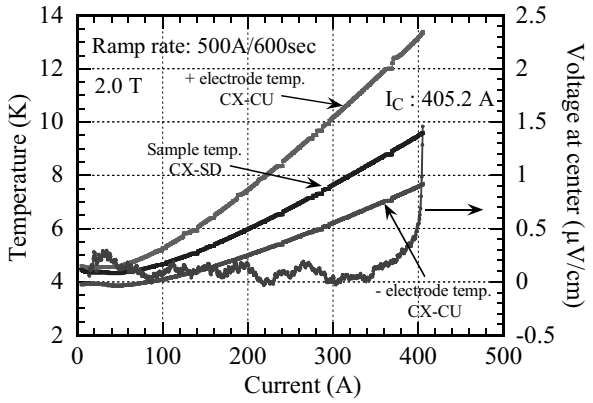


Fig. 4. Test results of $Nb_3Sn$ strand under 2.0 T. Ramp rate was 500A/600sec.