| MLF Experimental Report | 提出日 Date of Report |
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| 課題番号 Project No.<br>2010A0073<br>実験課題名 Title of experiment<br>Residual strain measurement for $Nb_3Sn$ strand cable by neutron diffraction<br>実験責任者名 Name of principal investigator<br>Hidetoshi Oguro<br>所属 Affiliation<br>Ibaraki University | 装置責任者 Name of responsible person<br>Toru Ishigaki<br>装置名 Name of Instrument/(BL No.)<br>BL 20 (iMATERIA)<br>実施日 Date of Experiment<br>2010.6.22 – 2010.6.24 |

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

CuNb reinforced $Nb_3Sn$ superconducting cable with stainless steel

Fig. 1 The CuNb reinforced $Nb_3Sn$ cable with stainless steel wires

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。)

Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

The $Nb_3Sn$ cables were stacked for neutron diffraction measurements. Edges of the cable were fixed by stainless steel wires and copper wires for keeping the shape of the cable and for thermal conduction. The stacked cables are shown in figure 2. The cables were attached to the cryostat for low temperature measurements. The residual strain was measured in the range from 300 K to 10 K. Neutron diffraction measurements were carried out in the axial and lateral direction by rotation of the samples.

The filament samples, which are the superconducting part of the $Nb_3Sn$ cable, were set to the vanadium holder. The holder was attached to the cryostat in order to measure the same temperature as measurements of the cable. Results of the filament samples were used for the strain-free lattice spacing of $Nb_3Sn$. The residual strain was estimated by a comparison of the lattice spacing between the cable and the filament sample.

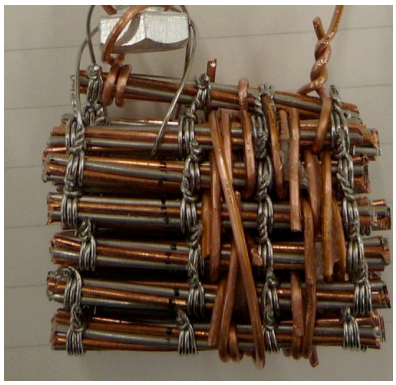

Fig. 2 The stacked $Nb_3Sn$ cables.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

Fig. 3 shows neutron diffraction patterns for $Nb_3Sn$ cables measured by iMATERIA. The lattice parameter of the $Nb_3Sn$ for the cable was calculated by some peak positions. The lattice parameter of the axial direction is 5.28737 Å and that of the lateral direction is 5.28736 Å at room temperature. The lattice parameter of filaments for the cable is 5.28718 Å at room temperature. The residual strain was determined by the comparison of the lattice parameters of the cables with those of the filament. The axial residual strain is 0.0037%, and the lateral one is 0.0034%. These results are consistent with the result of the prebent CuNb/$Nb_3Sn$ strand [1]. At low temperature (10 K), the lattice parameter of the axial direction was 5.27310 Å, that of the lateral direction was 5.27663 Å, and that of filaments was 5.27878 Å. From these results, the axial residual strain was -0.10750% and the lateral one was -0.04069% at 10 K. Residual strains at 10 K shows that the $Nb_3Sn$ in the cable was not applied large strain. We expected that the reason for bad critical current property of the cable at high magnetic field was the influence by the electromagnetic force. We need to measure the cables after the current carrying test in high field in order to understand the critical current property of the $Nb_3Sn$ cable.

Reference

[1] H. Oguro et al., J. Appl. Phys., vol. 101, 103913 (2007)

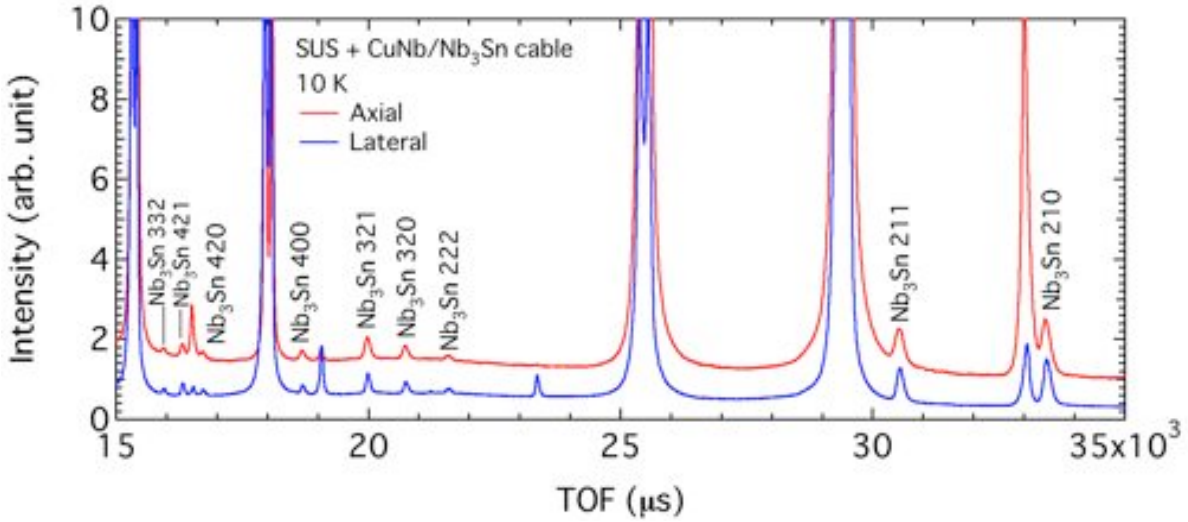


Fig. 3 The diffraction pattern for CuNb/$Nb_3Sn$ cables at 10 K. The red line is the axial direction and the blue line is the lateral direction.