MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2009B0028 実験課題名 Title of experiment Residual strain measurement for practical Nb_3Sn wire by neutron diffraction 実験責任者名 Name of principal investigator 小黒英俊 所属 Affiliation Ibaraki University	装置責任者 Name of responsible person 石垣徹 装置名 Name of Instrument/(BL No.) BL20 iMATERIA 実施日 Date of Experiment 2010/1/27 13:00 – 2010/1/29 10:00

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.

Solid sample : Internal-tin Nb_3Sn wires (Nb_3Sn, Cu, Nb, Cr)

Powder sample : Nb_3Sn filaments

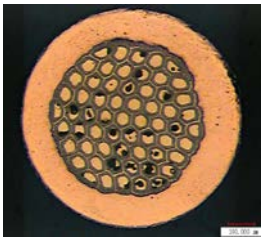


Figure 1 Cross sectional view of internal-tin Nb_3Sn wire.

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.

Experimental method

The internal-tin Nb_3Sn wires, which has been stacked for neutron diffraction measurements, are shown in figure 2. The wires were attached to the cryostat for low temperature measurements. We measured the residual strain 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 were set to the vanadium holder. The holder was attached to the cryostat in order to measure the same temperature such as measurements of wires. Experimental data resulted from measurements of filament samples were used for the strain-free lattice spacing. The residual strain was estimated by a comparison of the lattice spacing between the wire and the filament sample.

Figure 2 The stacked internal-tin Nb_3Sn wires

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

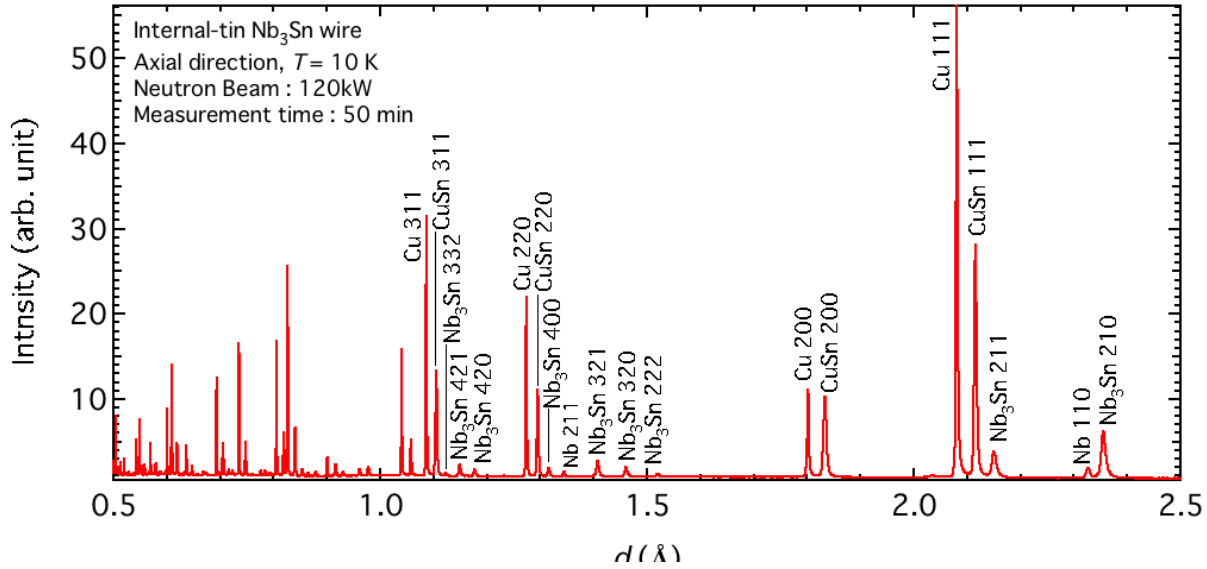
Results

Figure 3 shows the neutron diffraction pattern of internal-tin Nb_3Sn wires at 10 K. The measurement time of the result, which is the good enough counts for estimating strain correctly, was 50 minutes. The results revealed that only a few of Nb are left in the wires and filaments. We found that some Sn do not react with Nb since the large peaks of Cu-Sn alloy appear in the diffraction pattern.

The axial residual strain estimated from the data was −0.135% at room temperature, and −0.251% at 10 K. And the lateral residual strain was −0.013% at room temperature, and 0.143% at 10 K. These strain data show that a large lateral residual strain exist in internal-tin wires at low temperature.

In addition, we could measure the temperature dependence of residual strain because the measurement at each temperature was very fast. Figure 4 shows the thermal contraction of the Nb_3Sn wires. That figure shows that the residual strain of Nb_3Sn in the wires was changed linearly with increasing temperature.

Next, we will explore the process of changing the residual strain during cooling down to liquid Helium temperature (4.2 K) by using these results.



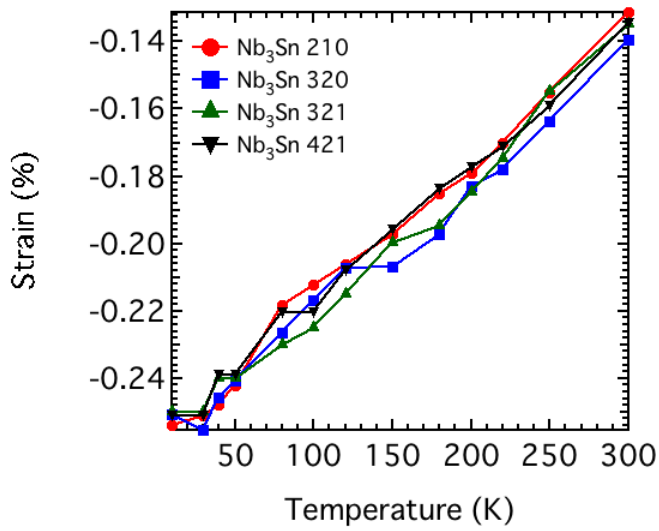


Fig. 4 The intrinsic strain of Nb_3Sn wires as a function of the temperature.