MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2009A0034 実験課題名 Title of experiment Three-dimensional strain analysis of the Nb_3Sn superconducting composite cables. 実験責任者名 Name of principal investigator Satoshi Awaji 所属 Affiliation IMR, Tohoku University	装置責任者 Name of responsible person Kazuya Aizawa 装置名 Name of Instrument/(BL No.) BL19 実施日 Date of Experiment 2009.11.24-26

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.

Twisted cable of 3 CuNb/Nb_3Sn wires + 4 stainless steel wires (dia. 1.0mm for each, whole diameter is about 3mm)

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 twisted Nb_3Sn cables with and without the impregnation by the Pb-Bi solder were used as samples. The cable consists of 3 CuNb/Nb_3Sn strands and 4 stainless steel wires as shown in Fig. 1. Those are fixed to the tensile test machine equipped to the Takumi. And the axial and lateral strains were measured under axial tensile loads by Norse and South banks at the same time, respectively. The macroscopic strain were also measured by both of the strain gauge adhered on each wire and the double extensometer mounted to the cable. Figure 2 shows the obtained stress-strain relations. The stress-strain relations of a few diffraction planes are almost similar each other for both samples, although the scattering of the data is large for the solder impregnated cable because of the solder's peaks near the Nb_3Sn peaks. The averaged data are summarized and compared to those of the Nb_3Sn strands in Fig. 3. We found that the twisted cables are more than 2 times stronger than the pre-bent CuNb/Nb_3Sn strands. In addition, the stress-strain properties of the cable are independent to the solder impregnation. This means that the twisted cable of Nb3Sn with SUS wires is

Figure 1 Photograph of the CuNb-Nb_3Sn/SUS twisted cable.

composite wires/cables and it determine the strain dependence of the superconductivity. Obtained results indicate that the effective Poisson ratio is almost similar for the same strand. Hence, the strain sensitivity of the superconductivity of the Nb_3Sn strands/cables is insensitive to the mechanical history and cable structures at least at room temperature. As a next step, the evaluation of the other Nb_3Sn wires is necessary in order to discuss the effects of the wire architectures on the strain sensitivity of superconductivity, in addition to the low temperature experiments.

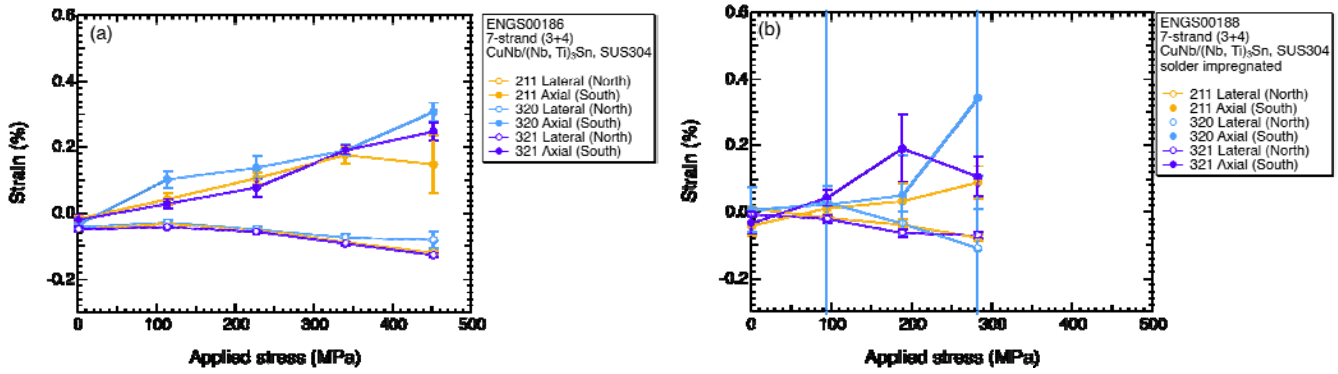

Figure 2　Stress–strain relations obtained from a few diffraction planes for CuNb/Nb3Sn cables (a) without and (b) with solder impregnations.

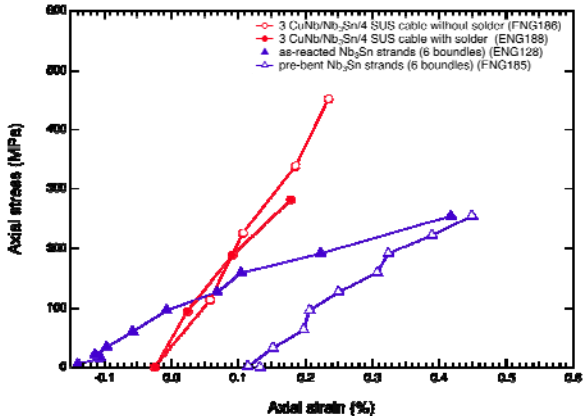

Figure 3 Comparison of stress–strain relations.

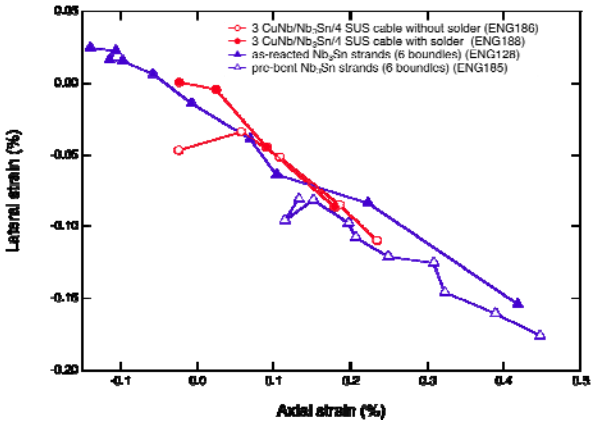

Figure 4 Relationship between axial and lateral strains for the cables and strands.