MLF Experimental Report	提出日 Date of Report **2010/06/23**
課題番号 Project No. **2009B0006** 実験課題名 Title of experiment **Competition behavior among static recovery, recrystallization of martensite and precipitation of austenite during annealing of cold rolled 17Ni-0.2C steel** 実験責任者名 Name of principal investigator **Pingguang XU** 所属 Affiliation **Quantum Beam Science Directorate, JAEA**	装置責任者 Name of responsible person **K. Aizawa /S. Harjo** 装置名 Name of Instrument/（BL No.） **TAKUMI/BL19** 実施日 Date of Experiment **2010/01/17 (first half)** **2010/05/27 (second half)**

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.

17Ni-0.2C steel, bulk specimens, 10mmx10mmx10mm.

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.

Ultrafine grained austenite-ferrite duplex steels have much better ductility than the conventional ultrafine grained ferrite-cementite steels, because the large volume of dispersive austenite increases work hardening and prevents the early necking phenomenon through the deformation induced martensite transformation and the transformation induced plasticity. The competition behavior between the precipitation of austenite and the recovery and recrystallization of martensite is thought to be necessary to be controlled during the preparation of above austenite-ferrite duplex microstructure. However, the conventional microstructure observation at room temperature is difficult to clearly describe the high temperature microstructure evolution because of the possible martensite transformation of metastable austenite during rapid cooling of specimen to room temperature.

In this neutron diffraction experiment, the principle investigator planned to compare the microstructure evolutions during *in situ* isothermal annealing at 773K, 823K, 873K by using TAKUMI time-of-flight neutron diffractometer, which involves the changes in phase volume fraction, lattice structure parameter and crystallographic orientation. Considering the *in situ* texture measurement attachment is not available, the partial texture evolution based on inverse pole figures will be carried out.

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

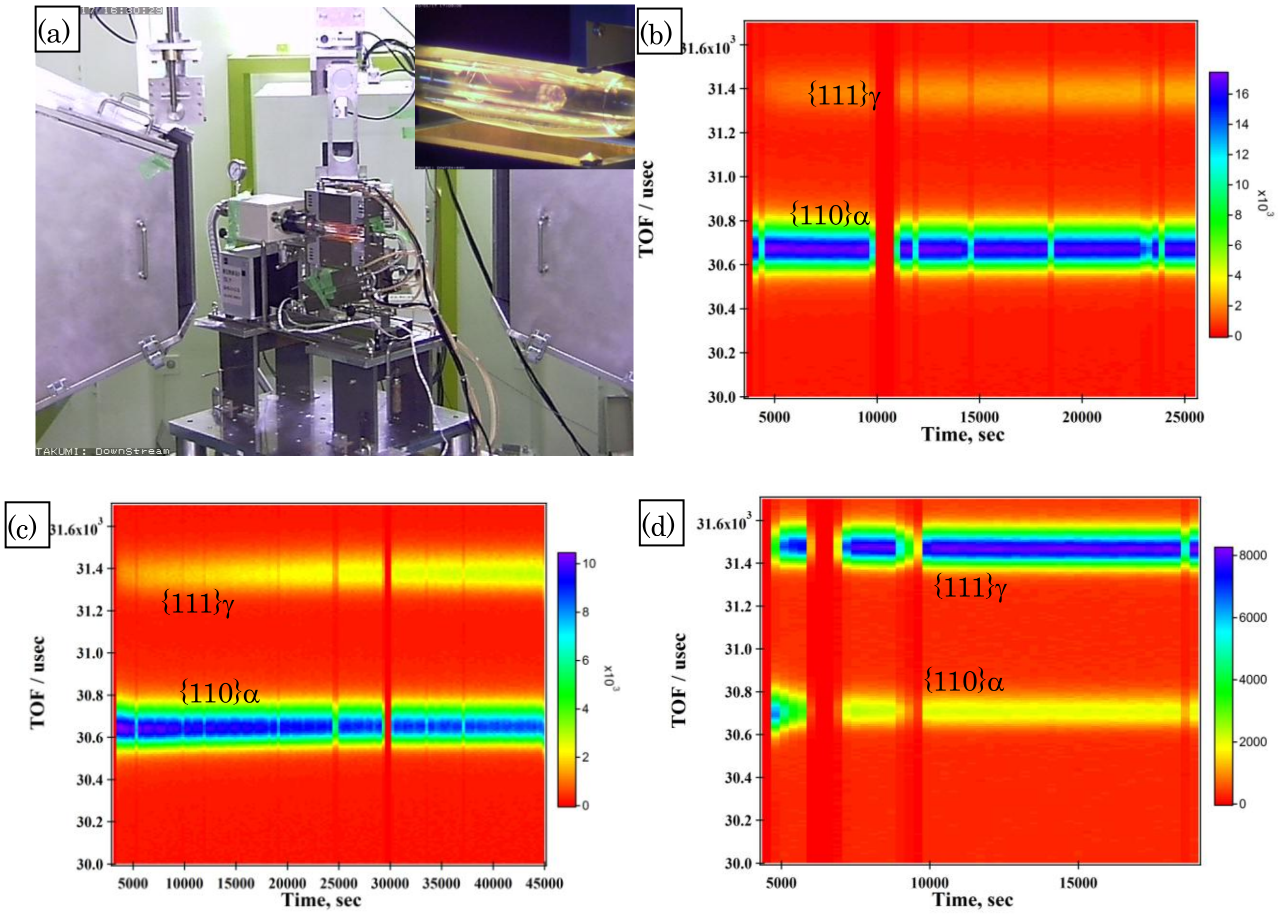

Fig.1 *In situ* neutron diffraction during isothermal annealing of cold rolled martensite steel 17Ni-0.2C: (a) View of furnace setup and sample setting in the quartz vacuum tube (inserted figure); (b) crystallographic evolution during isothermal annealing at 773K; (c) crystallographic evolution during isothermal annealing at 823K; (d) crystallographic evolution during isothermal annealing at 873K.

Fig.1 shows the view of in situ neutron diffraction experiment during isothermal annealing (a) and the changes in the neutron profiles by mapping images during the isothermal annealing at 773K (b), 823K (c) and 873K (d). At 773K, the austenite precipitation almost did not initiate before isothermal holding and the austenite transformation rate was relatively slow so that after 25 ks isothermal holding, the dominate phase was still the BCC phase. On the other hand, the peak of {110}α did not become shape, that is to say, the recrystallization behavior was not apparent during the isothermal holding, revealing that the BCC phase was the recovery martensite. At 823k, the austenite precipitation had already initiated and the {111}γ peak became stronger and stronger, revealing that the austenite precipitation was evident. For the BCC phase, the flatten {110}α peak became weaker and shaper, revealing that the cold rolled martensite was recrystallized during the austenite precipitation. That is to say, the competition behavior between austenite precipitation and ferrite recrystallization really occurred. At 873K, it is easy to found that the austenite transformation was dominated and transformation rate was relatively rapid.

Though the Rietveld analysis using GSAS software is still undergoing because of the difference between J-PARC/TAKUMI and ISIS/ENGIN-X neutron spectrum characteristics, the above primary data suggest that some important results can be obtained in the near future. This research was financially supported by the Grant-in-Aid of Young Scientists (No.21860090) of Japan Society for the Promotion of Sciences.