(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

MLF Experimental Report

提出日 Date of Report	
課題番号 Project No. 2016B0252	装置責任者 Name of responsible person AIZAWA Kazuya
実験課題名 Title of experiment In situ neutron diffraction study on bainite transformation below the Ms temperature	装置名 Name of Instrument/(BL No.) TAKUMI/BL19
実験責任者名 Name of principal investigator GONG Wu	実施日 Date of Experiment 2017/2/13~2/16 (3.5 days)
所属 Affiliation Kyoto University	

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.

A steel with the chemical composition of Fe-0.3C-2Mn-2Si(wt%) was used in this study.

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.

In-situ neutron diffraction experiments were conducted on the beam-line 19 'TAKUMI' at J-PARC with a thermomechanical processing simulator (Thermecmastor-Z) installed on it. As illustrated in Figure 1, two kinds of heat treatments were performed. In the first one, the specimens were fully austenitized at 900°C for 180s, and then rapidly cooled down to various temperature (330°C, 280°C, 250°C, 230°C) and held for 1.5 hours for isothermal transformation(1-step isothermal holding process). While the other was cooled down to 250°C, then reheated to 280°C and 330°C, and isothermally held (2-step isothermal holding process). By analyzing the neutron diffraction profiles, kinetics of phase transformations and changes of carbon concentration in each phase were tracked in real time.

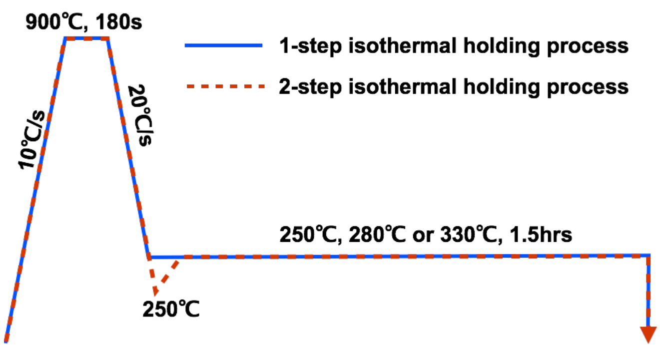

Figure 1 Heat treatment processes conducted in the *in-situ* neutron diffraction measurement.

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

The in situ neutron diffraction experiments during TMCP were successfully performed and the following results were obtained:

(1) The kinetics of phase transformation during austempering below the Ms (300°C) were measured. Figure 2a shows the volume fraction of the BCC phase (martensite and bainitic ferrite) during the austempering at 280°C. The volume fraction of martensite increased with the decrease of temperature from the Ms to 280°C. In the subsequent isothermal holding at 280°C, the increase of the BCC volume is corresponding to the bainite transformation.

(2) The carbon partition behavior during isothermal transformation was investigated. Figure 2b shows the lattice parameter of austenite evolution during the isothermal holding at 280°C. An apparent increase in the lattice parameter of austenite indicates that the carbon partition from the martensite and bainitic ferrite to austenite. The carbon concentration in the retained austenite decreased with the decrease of austempering temperature due to the decrease of carbon diffusion rate.

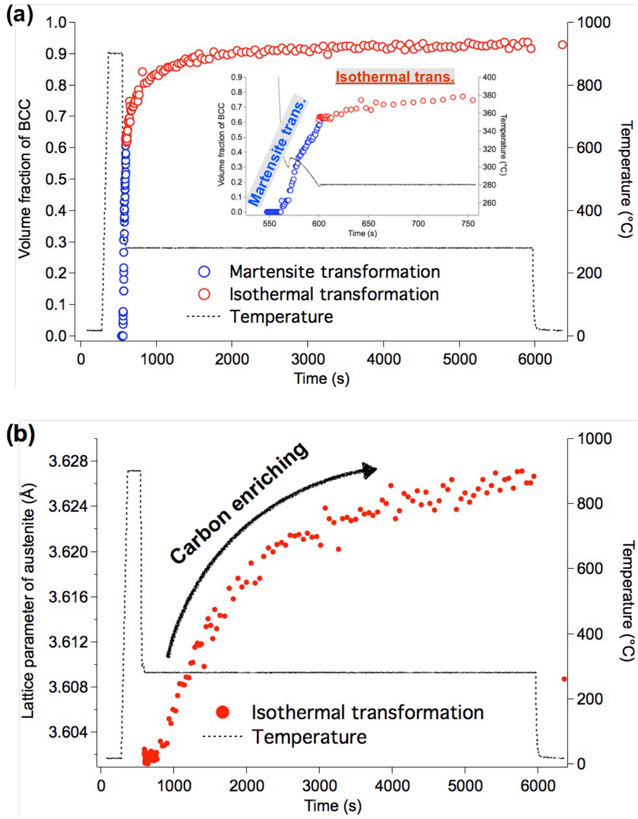

Figure 2 (a) The volume fraction of BCC phase (martensite and bainitic ferrite) (b) the lattice parameter of austenite evolutions during the austempering below the Ms.

(3) The specimen austempered at 250°C exhibited the highest volume fraction of austenite. It is the integrated results of various phenomena including martensite transformation, bainite transformation, carbon partition and carbide precipitation.