MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2012PM0003 実験課題名 Title of experiment 金属材料ナノ・ミクロ組織制御のリアルタイム測定技術の開発 Development of real time measurement technique for microstructural evolution in metals and alloys 実験責任者名 Name of principal investigator 友田 陽 (Y.Tomota) 所属 Affiliation 茨城大学(Ibaraki University)	装置責任者 Name of responsible person Yo Tomota 装置名 Name of Instrument/(BL No.) BL20 茨城県材料構造解析装置 iMATERIA 実施日 Date of Experiment 5 月 21 日—24 日 May 21–24, 2012 (57hs)

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.

Bulky solid steel specimens were used. The chemical compositions of three steels used are as follows:

(1) 0.79C–1.98Mn–1.51Si– 0.98Cr –0.24Mo –1.06Al–1.58Co-bal.Fe

(2) 0.6N-0.1C-16Cr-1Mo-0.2V-bal.Fe

(3) 0.6C-13Cr1.0Si-1.0Mn-0.5Ni-bal.Fe

(in mass%)

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.

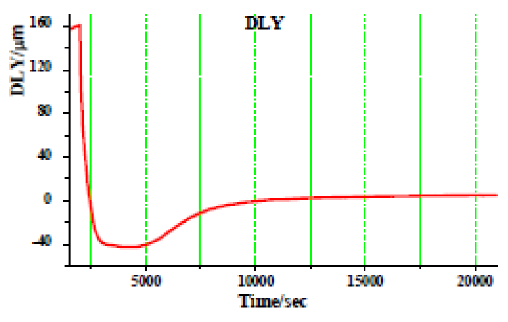

Fig. 1 Dilatometer data during processing.

A dilatometer was prepared through the fund of Grand in Aid for Scientific Research (A) #21246106 and installed into iMATERIA, successfully. The specimen (1) was heated up to 1173K and cooled to 573K followed by isothermal holding there in the ditalometer. The specimen length (DLY) was successfully monitored as shown in Fig.1, from which the dilatation due to austenite to bainite transformation was estimated. By changing the isothermal holding temperature, transformation mechanism and then the new product microstructure were strongly influenced. It is however, only the specimen size change can be found from the dilatometer data. The *in situ* neutron scattering measurements can give us very comprehensive information on transformation behavior. If we could obtain diffraction data as well as small angle scattering data simultaneously with dilatometer data, it would be helpful to have a progress for development of material production process. This is the reason why we chose iMATERIA for such a purpose.

The diffraction profiles obtained at the back bank were exhibited in Fig. 2. At 1173K in a single austenitic temperature region, only austenite peaks are visible with some peaks come from Pt foils used toachieve uniform temperature distribution. The Pt peaks were always observed through the present experiment.

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

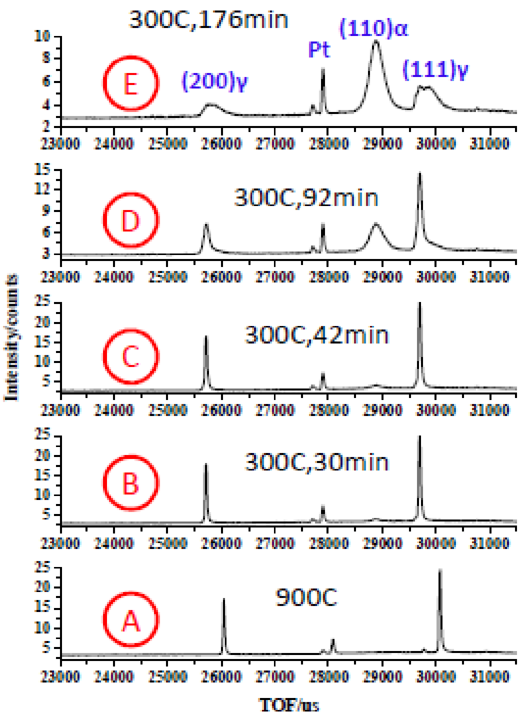

Fig. 2 Changes in diffraction profiles obtained at the back detector bank during the heat treatment.

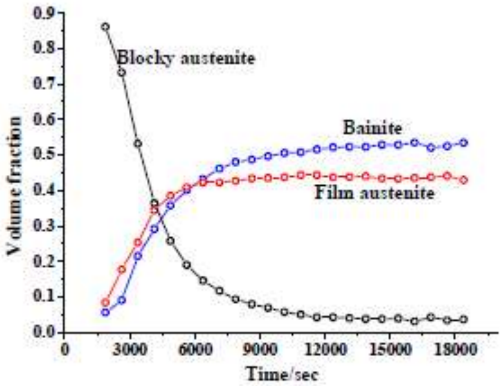

Fig. 3 Changes in volume fraction of two austenites (high C and averaged C) and ferrite as a function of holding time at 300C.

During holding at 573K (300C), the intensities for ferrite (bcc) increases while those of austenite (fcc) decreases indicating the progress of bainite transformation which shows good agreements with dilatometer data in Fig. 1. Here, the austenite can be divided into two regions with different carbon concentrations. Hence, the austenite diffraction peak, for example see (200) or (111) austenite peaks in Fig. 2, can be curve-fitted by double peaks, and then the volume fraction of the high carbon austenite film between bainitic ferrite laths can be separated from that of the averaged carbon bearing region (original matrix) in Fig. 3. When we analyze the data obtained at different banks, particularly small angle scattering bank, we would be able to find the information on texture, lattice strain, shape and size distribution of bainitic ferrite lathes. These seem to be affected by changing the heat schedule.

Another experiment done in this beam time was the tempering behavior of high nitrogen or high carbon bearing martensitic stainless steels, (2) and (3). The quenched martensite shows bct structure with high c/a ratio in bct unit cell. Interesting is that the c/a decreases with tempering in high carbon bearing martensite (3), while keeps almost the same value up to 773K in high nitrogen bearing martensite (2) as shown in Fig. 4. A new heat-resistant steel with high nitrogen content shows excellent corrosion resistance, hardness as well as good toughness, and then this unusual c/a behavior must help us to make clear the mechanisms showing such excellent properties.

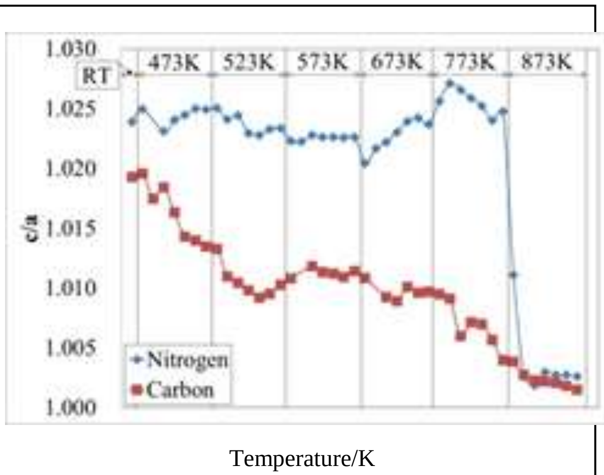

Fig. 4 Changes in the tetoragonality (c/a) in high nitrogen or high carbon bearing martensite steels (2) and (3) with tempering.