MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2012A0106 実験課題名 The lattice strain response to characterize the new mechanisms on superelastic behavior of pre-martensite for NiFeGaCo alloy 実験責任者名 Name of principal investigator Yandong Wang 所属 Affiliation Beijing Institute of Technology	装置責任者 Name of responsible person Stefanus Harjo 装置名 Name of Instrument/（BL No.） BL-19 TAKUMI (J-PARC) 実施日 Date of Experiment 2012-06-25 to 2012-06-27

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.

$Ni_{46}Fe_{18}Ga_{27}Co_9$ and $Ni_{43}Fe_{18}Ga_{27}Co_{12}$

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.

Method: Some cylindrical samples with the diameter of 8 mm and the length of 16 mm were used to study the responses of different *hkl* diffraction plans during in-situ loading attached in TAKUMI. Two ±90 °detector banks were be used for collecting the lattice strains along the loading direction and the transverse direction.

Results: Ni46Fe18Ga27Co9 (The normal parent phase):The macroscopic stress–strain curve recorded during the in situ uniaxial compression experiment (FIG.1a) shows three distinct stages, namely elastic loading up to 200 MPa, martensitic phase transformation above 200 MPa and reverse phase transformation during unloading. In the axial spectra (FIG.1b), the martensitic $(220)_M$, $(200)_M$ and $(112)_M$ peaks emerge during the second stage and the Heusler $(200)_P$ peaks do not vanish when the applied stress reaches the max stress. The evolution of lattice strains for different hkl-planes (FIG.3a), which measured along the loading direction as a function of the applied compressive stress, reveals clearly an anisotropic behavior of the Heusler phase during loading and unloading.

$Ni_{43}Fe_{18}Ga_{27}Co_{12}$ (The strain glass state): The macroscopic stress–strain curve recorded during the in situ uniaxial compression experiment(FIG.2a) shows four stages, namely elastic loading up to 166 MPa, pre-martensitic phase transformation between 166 and 266 MPa, martensitic phase transformation above 266 MPa and reverse phase transformation during unloading.

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

FIG.2b shows that no new peaks emerge during the pre-martensitic phase transformation. However, the slope of elastic strain v.s. applied stress for the elastic deformation region is different from that for the pre-martensitic phase transformation for both the $(220)_P$ and $(400)_P$ (F IG.3b).

Summary: Compare with the normal parent phase, a new stage called as pre-martensitic phase transformation exists in the strain-glassy state during the uniaxial compression. In the pre-martensitic phase transformation, no new diffraction peaks appear and macro elastic modulus remains the same as that in the elastic deformation. Yet, the evolution of lattice strains indicates that the elastic modulus for hkl-planes is different in the two stages.

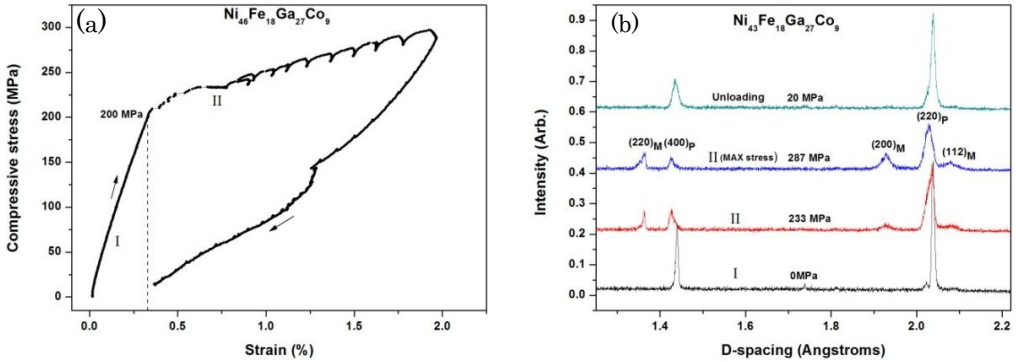

FIG. 1. Macroscopic stress–strain curve recorded (a) and diffraction profiles for the $(220)_P$ and $(400)_P$ along the loading direction (b) of $Ni_{46}Fe_{18}Ga_{27}Co_9$.

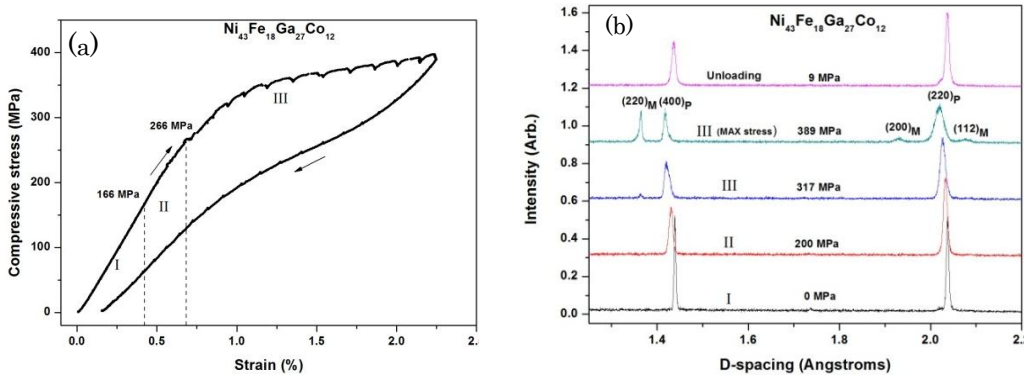

FIG. 2. Macroscopic stress–strain curve recorded (a) and diffraction profiles for the $(220)_P$ and $(400)_P$ along the loading direction (b) of $Ni_{43}Fe_{18}Ga_{27}Co_{12}$.

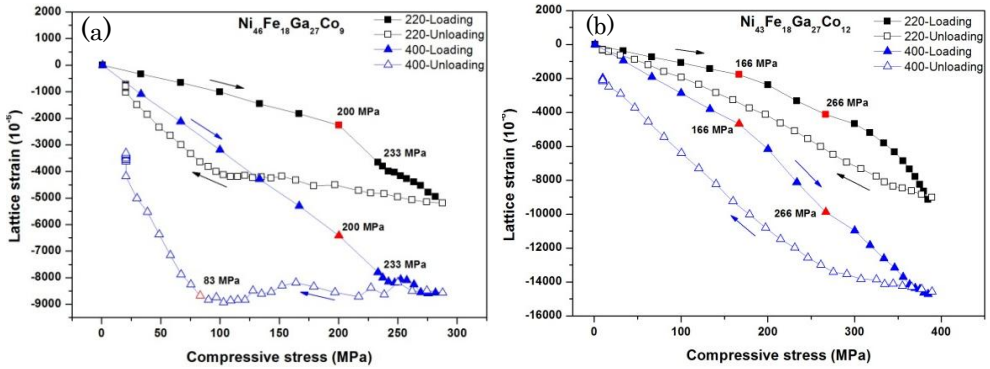

FIG. 3. Lattice strain evolution along the loading direction for the $(220)_P$ and $(400)_P$ reflections of $Ni_{46}Fe_{18}Ga_{27}Co_9$ (a) and $Ni_{43}Fe_{18}Ga_{27}Co_{12}$ (b).