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Precursor Phenomenon of Martensitic Transformation in FePd Alloy Observed by Various Wavelengths

T. Ohba[1], M. Mitsuka[1], T. Fukuda[2], T. Kakeshita[2], M. Tanaka[3]
[1]Shimane University, Depart. of Materials Science, Matsue 690-8504, Japan.
[2] Osaka University, Materials Science and Engineering, Suita 565-0971, Osaka, Japan.
[3]KEK-PF, Tsukuba, 305-0801, Japan

Introduction

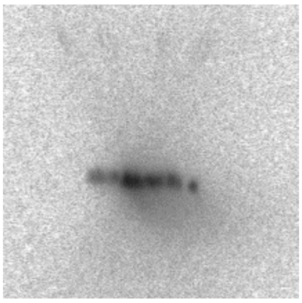
Martensitic transformation is typical first-order and displacive transformation. The transformation has been utilized for steel-hardening. Shape memory effect and super-elasticity are also caused by the transformation. However, the mechanism of the transformation has not been solved completely. In this experiments, FePd was used for understanding the transformation.

FePd is one of typical alloys showing martensitic transformation, whose behavior is closer to second-order transformation. Studies of precursor phenomenon on FePd alloys were performed by several researchers. Sugiyama et al.[1] reported tweed patterns along [110] observed by electron microscopy. Muto et al.[2-3] observed high-resolutin-electron-microscopy and reported results of simulations under the assumption of irregularly distributed modulated cubic. Seto et al.[4] carried out X-ray and neutron experiments and reported two-phases mixtures with tetragonal lattices prior to the martensitic transformation. Phonon behavior was also studied by Sato[5].

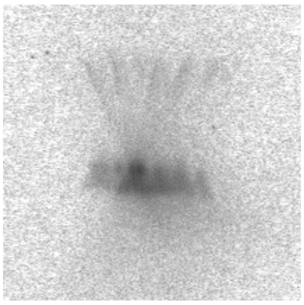
In this experimental research, synchrotron radiation experiments were performed. Several wavelengths were chosen to see a depth effect on the precursor phenomenon.

Experimental

Single crystal of Fe-31.2at%Pd with 6 mm diameter and 2 mm thickness is prepared with mechanical polished (100) plane after heat treatment to exclude stress. The X-ray diffraction experiments were carried out by vertical type 4-circle diffractometer, BL-10A, at Photon Factory in KEK. Wavelengths λ = 0.55 Å, 0.70 Å, 0.85 Å, 1.00 Å, 1.50 Å and 1.70 Å were monochromatized by Si(111) single crystal monochromator. Oscillation photographs were taken on IP (Imaging Plate) to observe the diffraction patterns. Temperature was controlled by Oxford Cryostream system.



(a)



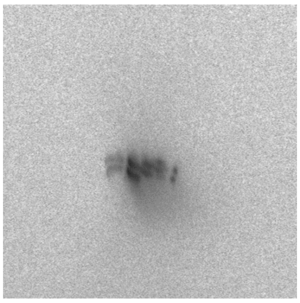
(b)

Figure 1 Enlarged 400 reflection with wavelength λ=0.85Å. (a) shows photograph exposed at 190 K. (b) shows photograph at 193 K.

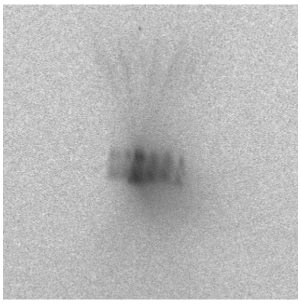
Results and discussions

Figure 1 shows enlarged oscillation photographs around 400 Bragg reflection observed with wavelength λ=0.85Å. Splitting of Bragg reflection was caused by mosaic of the crystal. Although the mosaic structure of the sample made the situation difficult, essential feature can be seen. Comparing (a) and (b) made us notice that decreasing temperature weakened diffuse streak.

Figure 2 shows 400 Bragg reflection and diffuse streaks observed with wavelength λ=1.0Å. Appearance of Bragg reflections and diffuse streaks looks different from Fig. 1. Those observations with several wavelengths revealed the characteristics of transformation phenomena.



(a)



(b)

Figure 2 Enlarged 400 reflection with wavelength λ=1Å at (a) 190 K and (b) 193 K.

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