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TEM Study of Polycrystalline Co-Ni-Ga for Applications of Shape Memory Alloys

M. Sanchez-Carrillo[1], J. P. Flores de los Rios[2], H. Morales-Rodriguez[1], J. Ramos-Cano[3], A. Santos-Beltran[1] and V. Gallegos-Orozco[1]

[1] Universidad Tecnológica de Chihuahua Sur, Chihuahua. Chih. México.
[2] Facultad de Ingeniería, Universidad Autónoma de Chihuahua, Chihuahua, Chih., México.
[3] Facultad de Metalurgia, Universidad Autónoma de Coahuila, Monclova, Coah., México.

Studies on several candidates for shape memory alloys have been carried out: Fe–Pd, Fe–Pt, Ni–Mn–Al, and Co–Ni–Al **[**1**,**2**]** in order to find out new alternative materials with lower brittleness. Recently, Ni–Fe–Al **[**3**]** and Co–Ni–Ga **[**4**]** have been considered as good ferromagnetic shape-memory alloys candidates, mainly due to the presence of a γ phase (disordered fcc A1) that improves ductility in these kind of alloys **[**5**].** The aim of this paper is to determine the martensitic and austenitic transformation of polycrystalline Co38.3Ni32.1Ga29.6 alloy.

To analyze the crystalline structure it was used XRD and TEM techniques. Figure 1 shows the X-Ray diffraction pattern where main peaks at 43.5º and 47.5º of 2 theta were indexed to be martensite + γ-phase; M{(110), (122)}c and γ {(111), (110)} respectively. The diffraction pattern shows two structures, where the precipitate phases do not martensitically transform but this γ-phase improves the homogeneity and ductility of alloy, see Figure 2.

Moreover, TEM analysis was used to verify the martensitic phase and γ-phase. Figure 2a) shows clearly the twinned martensite structure matrix. The figure 2 b) shows the diffraction spots patterns for martensitic, obtained from the region marked with a red box in (zone1 Figure 2b), It was indexed as shown in crystallographic analysis of the planar spacing correspond to the (200), (202), and (002) planes of the martensite phase observed in the [0 −4 0] zone axis. As well as, in the Figure 2c) show the diffraction spots patterns for γ-phase, obtained from the region marked with a red box in (zone1 Figure 2a).

The crystallographic analysis of the planar spacing correspond to the (100), (101), and (001) planes of the martensite phase observed in the [1 −1 0] zone axis. The lattice parameters of martensite and γ-phase are determined to be; a = b = 0.386 nm and c = 0.334 nm for martensite (tetragonal structure), a = 0.3597 nm for the fcc. Thanks to the HRTEM technique was possible identify the phases present in the material and proving to be an excellent tool for microstructural characterization of nanomaterials.

References:

[1] K. Oikawa, *et al*, Applied Physics Letters, **79** (2001) p. 3290.
[2] H. Morito, *et al*, Applied Physics Letters, **81** (2002) p. 1657.
[3] S. Kaul, *et al* Applied Physics Letters, **89** (2006) p. 093119.
[4] K. Oikawa, *et al*, Materials Transactions-JIM, **42** (2001) p. 2472.
[5] R. Kainuma, *et al*, Intermetallics, **4** (1996) p. S151.

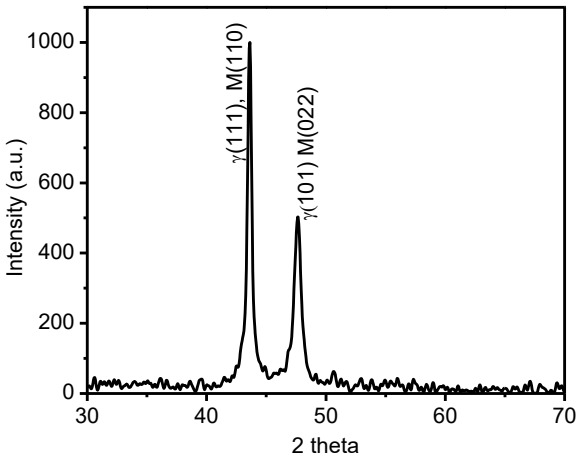

Figure 1. X-ray diffraction pattern of the Co38.3Ni32.1Ga29.6 alloy at room temperature.

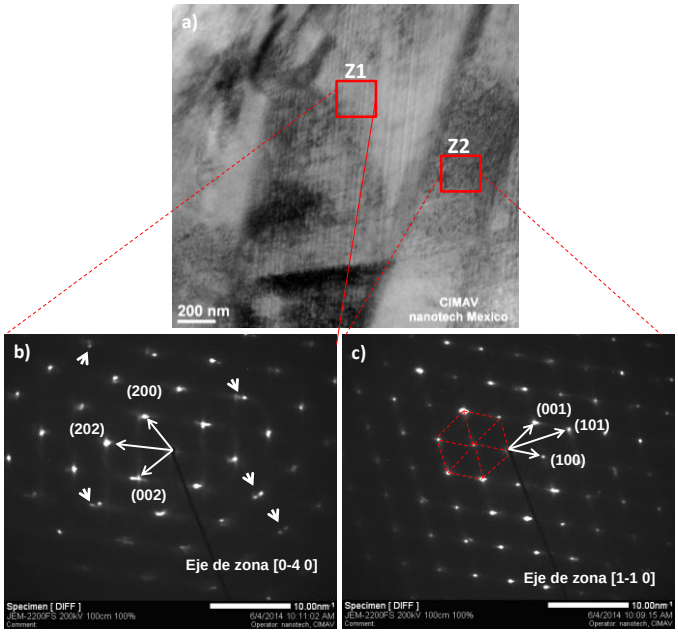

Figure 2. a) TEM microstructure of the Co38.3Ni32.1Ga29.6, b) Zone 1 and c) Zone 2 of diffraction spots patterns for martensitic matrix and precipitated γ-phase respectively.

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