

# Martensitic Transformation Features of Ni-Fe-Ga-Ge Ferromagnetic Microwires

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Here we report on the internal structure and magnetic properties in Ge-doped Ni-Fe-Ga rapidly quenched glass-coated microwires with the chemical composition of  $\text{Ni}_{51.69\pm 0.28}\text{Fe}_{26.97\pm 1.09}\text{Ga}_{21.34\pm 0.82}$  (SX0) and  $\text{Ni}_{51.96\pm 0.03}\text{Fe}_{23.75\pm 0.14}\text{Ga}_{21.54\pm 0.06}\text{Ge}_{2.75\pm 0.11}$  (SX3). The diameter of an inner core of SX0 microwire has been determined as  $d = (16.2\pm 0.4)$   $\mu\text{m}$  and SX3 microwire as  $d = (12.0\pm 0.2)$   $\mu\text{m}$ . Glass coating thickness varied from 14 to 16 microns for both type of microwires.

The samples were cut by focused ion beam to perform cross-section measurements on SEM. Vertical lines on the image are the result of ion beam cutting. Bright areas show number of parallel lines from border to border of the microwire. Dark areas are situated close to the center of the sample and can be characterized by parallel lines but of different angle. The first type of lines are martensitic variants with the distance between the lines around 750-800 nm. The second type can also be classified as martensitic variant but of another phase. The cross-section of the second wire have the same features with additional bright areas (Fig. 1).

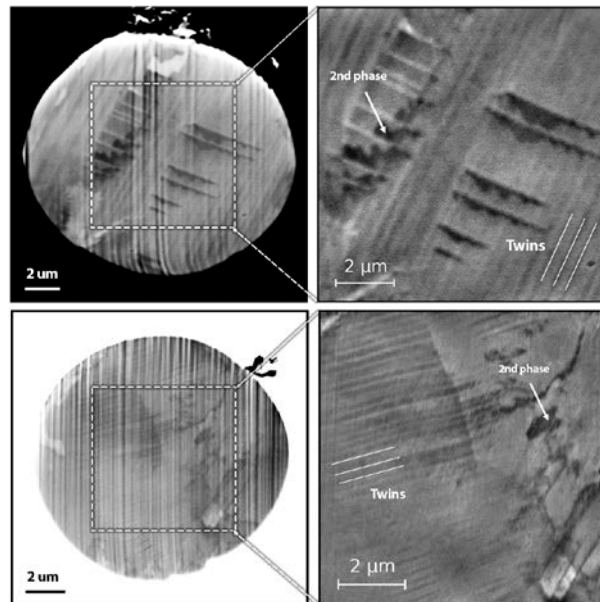


Figure 1: SEM images of the cross-section of the SX0 (left) and SX3 (right) microwires

X-ray diffraction measurements at room temperature showed that SX0 wires are in martensitic state and the gamma phase is absent. SX3 microwires demonstrate intermediate state with austenite and martensite phases, which means that substitution of iron on germanium leads to the shift of MT towards low temperatures. The measurements of magnetic properties confirmed the assumption and revealed the influence of germanium.