Thermo-magnetic and thermo-electric characteristics of Fe-Mn-Ga magnetic shape memory alloy

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The change of crystallographic structure induced by thermo-magnetic and themo-electric hysteresis loops described martensitic transformation, has become particularly significant because its usage in magnetic field induced stents, magnetic actuation and sensing application [1-3]. Nevertheless , magnetic field induced magnetic shape memory effects are not observed in Ni-Ti alloys apart from their fascinating shape memory effects [4-5]. Here, we report the observation of magnetic field induced magnetic shape memory effects in glass-coated non-stoichiometric $Fe_{42.8}Mn_{27.6}Ga_{29.6}$ Heusler microwire using structural, thermo-magnetic and thermo-electric measurements. The X-ray diffraction profile revealed the coexistence of a low-temperature phase with the $L1_2$ structure (a = 3.71 Å) and a high-temperature $L2_1$ phase (a = 5.88 Å), can be considered as evidence for the shape memory effect anticipated in Fe-Mn-Ga-based Heusler alloys. The temperature dependence of magnetization revealed thermal hysteresis of magnetization during the heating and cooling process, and magnetic hysteresis loops point to the change in the direction of the easy magnetization axis of the low- and high-temperature phase. The unusual behavior of the permeability and electrical resistance measurements are in good agreement with the magnetic measurements. In the presented glass-coated microwire, it is not only possible to shift the transformation temperature with the external magnetic field, but from its initial permeability value, it is possible to determine whether the alloy has undergone the structural transformation. Therefore, the presented Fe-Mn-Ga-based glass-coated microwire would be a candidate for micro-actuators with sensing applications.

Acknowledgement: *RV thanks FCT grant o. SFRH/BPD/104887/2014.*

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