Giant magnetic field-induced strains in textured Ni-Mn-Ga and Ni-Mn-Ga-Fe melt-spun ribbons

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Ni-Mn-Ga magnetic shape memory alloys have gained much attention since they exhibit large magnetic field induced strains ensuring a wide range of possible applications as actuators, sensors, medical pumps etc.
In this work, the microstructure and texture of Ni-Mn-Ga and Ni-Mn-Ga-Fe melt-spun ribbons showing five-layered 10M and seven-layered 14M martensites, respectively, were examined by high-energy synchrotron radiation, electron backscatter diffraction and transmission electron microscopy. Moreover, based on textured measurements the magnetic field-induced strains were calculated. Firstly, the as-spun ribbons were heat treated in order to increase an atomic order degree and optimize microstructure, as well as crystallographic texture affecting their functional properties. It was found that in both cases appropriate thermal treatment at 1173 K for 72 h ensured a homogenous <100> fiber texture with the grain size along the entire ribbon thickness. A uniform radial microstructure allowed for in-plane stress/strain compatibility giving rise to strain accommodation during variant reorientation and consequently large value of giant magnetic field induced strains of about 1.5%.

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