Abstract

The present study reports on direct magneto-microstructural observations made during the stress-induced martensitic transformation in Co-Ni-Ga and Ni-Fe-Ga ferromagnetic shape memory alloy single crystals. The ramifications of the results with respect to the magneto-microstructural coupling that may cause the magnetic shape memory effect in these alloys under constant external stress is addressed.

For the Co-Ni-Ga crystals the evolution of the microstructure and the associated magnetic domain morphology as a function of applied strain were investigated in the as-grown, thermo-mechanically trained, homogenized and aged condition. Each treatment alters the martensite formation mechanisms and the magnetic domain configuration and therefore, the magneto-mechanical coupling for each condition is different.

The Ni-Ga-Fe alloy was investigated in the as-grown condition and two orientations [100] and [123] were studied. The results demonstrated that not only the stress-induced martensite and the magnetic domain structure evolve quite differently in the two orientations, but also depending on the atomic structure, the behavior of the [100] oriented crystals among each other is dissimilar.

The results of this work show that Co-Ni-Ga alloys in the thermo-mechanical trained condition and [100]-oriented Ni-Fe-Ga alloy single crystals with formation of modulated martensitic structures have the greatest potential for magnetic shape memory applications.