NATO Advanced Research Workshop

Functional Spintronic Nanomaterials
for Radiation Detection and Energy Harvesting

This workshop is supported by: The NATO Science for Peace and Security Programme

Magnetic dynamics in nanotwinned epitaxial films of magnetic shape memory alloys

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The hierarchic twin structure of martensite of magnetic shape memory alloys, formed as a result of minimization of elastic energy down to atomic scale, is under intensive study nowadays. On the other hand, the much more sophisticated problem of the relationship between nanoscale twin structure and the magnetism has been tackled only recently. Martensitic transformation (from the cubic austenite phase to the lower symmetry martensitic structure) in thin films cannot occur without twinning, due to a surface area conservation requirement. Twinning in the magnetic shape memory films can lead to periodic magnetic structures and the periodicity at submicron level can be achieved without any lithography, only by adjusting the film composition and its thickness, as well as a proper selection of the substrate.
It will be shown that the nanotwin structure affects not only the basic magnetic parameters of magnetic shape memory alloys, but also can change qualitatively its magnetic nature and related magnetodynamic properties. This will be illustrated, both theoretically and experimentally, on the prototype Ni–Mn–Ga and Ni(Co)–Mn–Sn epitaxial thin films, but the conclusions are also valid for other Heusler-type magnetic shape memory alloys, both in the form of thin films, ribbons and bulks.