In situ cyclic micro deformation of a NiMnGa ferromagnetic shape-memory alloy with concurrent AE detection

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Abstract

Ferromagnetic shape memory alloys (FSMAs), such as NiMnGa alloys, possess the unique combination of large displacements and fast mechanical response which offers novel prospects for applications that make use of the mechanism of converting between magnetic and mechanical energies.
The measurement of acoustically emitted (AE) waves that are generated by rapid changes of the local strain field that occur during the plastic process through which the material responds to stress. These measurements are much more sensitive than macroscopic ones and are capable of detecting events with an energy down to 1 aJ and below.

During our experiments, we prepared a tension-compression microsample from a single-crystal FSMA, which was cyclically deformed using a custom-developed in situ nanoindenter, which is also suitable for AE detection. The deformation took place through the expected twinning process and it was accompanied by significant AE. The stress-strain data revealed that during compression, twinning typically occurs at high mechanical stresses, followed by a stress drop and AE signals, while during tension, AE signals associated with stress drop appear in the low-stress ranges of the loading and unloading sections.
In my presentation, I will showcase our results related to the investigation of AE signals generated by different type of mechanical twinning. These analyses could be suitable for providing information about microscopically precise mechanical processes based solely on AE.

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