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# Ferromagnetic shape memory alloy microwires

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## ABSTRACT

Ferromagnetic shape memory alloys exhibit multifunctional properties such as shape memory effect, superelasticity, magnetic-field-induced strain (MFIS), and magnetocaloric effect (MCE). Various forms of these alloys, i.e., foams, films, and microwires, are thought to be facile ways to modify their properties. Here, microwires of Ni–Mn–Ga, Ni–Mn–Ga–Cu, and Ni–Mn–Sn alloys were successfully synthesized by a modified melt-extraction method on a large scale. The microwires have diameter of 20–80  $\mu\text{m}$  and length of several centimeters. Fine grains may be found in the as-fabricated microwires. Oligocrystalline grains or bamboo grains may also be created in the microwires by grain growth or chemical ordering heat treatments. Shape memory effect, superelasticity, and MCE were demonstrated in these microwires. These microwires may act as promising materials for new kind of micron devices and fillers of composite materials.

**KEYWORDS:** shape memory alloys, microstructure, grain, shape memory effect