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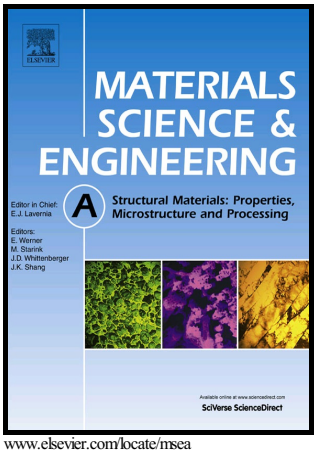

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Abstract

A martensitic TiNi shape memory alloy was processed by high-pressure torsion (HPT) for 1.5, 10 and 20 turns followed by post-deformation annealing (PDA) at 673 and 773 K for various times in order to study the microstructural evolution during annealing and the shape memory effect (SME). Processing by HPT followed by the optimum PDA leads to an appropriate microstructure for the occurrence of a superior SME which is attributed to the strengthening of the martensitic matrix and grain refinement. A fully martensitic structure (B19' phase) with a very small grain size is ideal for the optimum SME. The results indicate that the nanocrystalline microstructures after PDA contain a martensitic B19' phase together with an R-phase and this latter phase diminishes the SME. Applying a higher annealing temperature or longer annealing time may remove the R-phase but also reduce the SME due to grain growth and the consequent decrease in the strength of the material. The results show the optimum procedure is a short-term anneal for 10 min at 673 K or only 1.5 min at 773 K after 1.5 turns of HPT processing to produce a maximum recovered strain of ~8.4% which shows more than 50% improvement compared with the solution-annealed condition.

Keywords: Crystallization; Nanostructured materials; Severe plastic deformation; Shape memory effect; TiNi alloys.

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