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Prof. Jaume Pons

Professor

Dept. of Physics
University of the Balearic Islands

High Temperature Shape Memory Alloys Based on Ni-rich Ni-Ti-Hf and Ni-Ti-Zr

There is an increasing interest from automotive, aerospace, manufacturing and energy exploration industries in shape memory alloys capable to be used as high-temperature actuators, working at temperatures well above 100 °C. In this way, intense research has been done on ternary additions to binary Ni-Ti SMAs to raise the transformation temperatures and preserve at least part of their exceptional functional properties. Ternary alloys with Pd or Pt macroalloying in substitution of Ni fulfill these requirements. A cheaper alternative is the addition of Hf or Zr substituting Ti. In particular, Ni-rich Ni-Ti-Hf and Ni-Ti-Zr alloys are considered serious candidates for High Temperature Shape Memory Alloys since they exhibit good mechanical and functional properties around 200 °C when precipitation of H-phase is induced by controlled thermal treatments. The size and density of the H-phase precipitates, which are related with the parameters of the thermal treatments, can heavily influence the transformation temperatures and mechanical properties of these alloys. This presentation will review the structure of the H-phase, its accommodation with the austenite and martensite matrix and the effects on functional properties. The stability of the microstructure and functional properties of Ni-rich Ni-Ti-Hf and Ni-Ti-Zr upon long exposure of the material to high working temperatures will be also presented.

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