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Microstructure and phase transformation behavior of a new high temperature NiTiHf-Ta shape memory alloy with excellent formability

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Microstructure, mechanical properties as well as phase transformation behavior of newly developed $Ni_{49}Ti_{36}Hf_{15-x}Ta_{(x=0,\ 3,\ 6,\ 9,\ 12)}$ high temperature shape memory alloys has been investigated. $Ni_{49}Ti_{36}Hf_{15}$ alloy consists of $(Ti,Hf)_2Ni$ phase which is brittle and incoherent with the martensite matrix. However, addition of Ta in place of Hf suppresses the brittle $(Ti,Hf)_2Ni$ phase formation with white Ta rich phase. More than 70% reduction in area has been observed in Ta added $Ni_{49}Ti_{36}Hf_{15}$ high temperature shape memory alloys. The austenitic transformation temperature is well above 200ºC (473K) for lower Ta concentrations with up to 6 at. %; however; at higher Ta concentrations (i.e. above 9 at. %) decreases significantly. Overall, the addition of Ta greatly influences the hot deformation behavior and high temperature shape memory properties of $Ni_{49}Ti_{36}Hf_{15}$ alloy. The present paper discusses the detailed investigation on $Ni_{49}Ti_{36}Hf_{15-x}Ta_{(x=0,\ 3,\ 6,\ 9,\ 12)}$ high temperature shape memory alloys.

Keywords: Shape Memory Alloy, NiTi-Hf-Ta alloy, Phase Transformation, Precipitate, Microstructure