



Mechanical activation of pre-alloyed NiTi₂ and elemental Ni for the synthesis of NiTi alloys

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ABSTRACT

This work reports on an efficient powder metallurgy method for the synthesis of NiTi alloys, involving mechanical activation of pre-alloyed NiTi₂ and elemental Ni powders (NiTi₂-Ni) followed by a press-and-sinter step. The idea is to take advantage of the brittle nature of NiTi₂ to promote a better efficiency of the mechanical activation process. The conventional mechanical activation route using elemental Ti and Ni powders (Ti-Ni) was also used for comparative purposes. Starting with (NiTi₂-Ni) powder mixtures resulted in the formation of a predominant amorphous structure after mechanical activation at 300 rpm for 2 h. A sintered specimen consisting mainly of NiTi phase was obtained after vacuum sintering at 1050 °C for 0.5 h. The produced NiTi phase exhibited the martensitic transformation behavior. Using elemental Ti powders instead of pre-alloyed NiTi₂ powders, the structural homogenization of the synthesized NiTi alloys was delayed. Performing the mechanical activation at 300 rpm for the (Ti-Ni) powder mixtures gave rise to the formation of composite particles consisting in dense areas of alternate fine layers of Ni and Ti. However, no significant structural modification was observed even after 16 h of mechanical activation. Only after vacuum sintering at 1050 °C for 6 h, the NiTi phase was observed to be the predominant phase. The higher reactivity of the mechanically activated (NiTi₂-Ni) powder particles can explain the different sintering behavior of those powders compared with the mechanically activated (Ti-Ni) powders. It is demonstrated that this innovative approach allows an effective time reduction in the mechanical activation and of the vacuum sintering step.

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