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Effects of sintering temperature on grain growth of NiTiCu shape memory alloy

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Abstract

Nickel-titanium based shape memory alloys (NiTi SMAs) are extensively used in the biomedical field due to its unique properties such as superelasticity and shape memory effect. The martensite transformation can be executed in SMAs using these unique properties. The martensite transformation can be mainly influenced by the size of the grains presented in the alloy. Therefore, the control of grain size as per the requirement is a crucial in smart materials development. In this work, the nickel-titanium-copper (NiTiCu) SMA has been developed using spark plasma sintering (SPS) process at different temperatures. The sintering temperature is a significant factor that influences the size of grains in the consolidated alloys. The formation of grains in the sintered alloys has been evaluated with respect to the temperature which led to the formation of precipitates such as Ni_3Ti, Ni_4Ti_3 and Ni_3Ti_2 in the SMA. The effects of sintering temperature on the grain size have been investigated using computational thermokinetics at different temperatures such as 700 °C, 800 °C and 900 °C. Moreover, the same has been carried out in experimentally and evaluated using transmission electron microscope (TEM) analysis. The results of the simulation and experiment exhibited the trend of the growth of grain with an increase of sintering temperature. In addition to these, the dislocation density, sub-grain size and recrystallized fractions were investigated on the sintered alloy.

Keywords:

NiTi, Shape memory alloy, Spark plasma sintering, Grains, Precipitates

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