Vol. 13, No. 3, 2004

Study of the SHS Synthesis Of Ti-Al Foams

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ABSTRACT

This work studies how to obtain Ti-Al-based porous material by self-propagating high-temperature synthesis (SHS). Due to the low exothermicity of this system and the passive nature of the starting powders (mainly owed to surface oxidation), there exist great difficulties to realise the synthesis reaction in a wave propagation mode. This problem has been tackled and successfully solved by the use of chemically activated process. It has been found that the same product used as chemical activator also plays the role of foaming agent. Consequently, intermetallic foams have been successfully synthesized by this method. The investigation has been divided in two main parts:

First, the phase formation of the product was studied. It was shown that besides the dominant TiAl phase, a ternary phase ($Ti_4Al_2C_2$) was also obtained, coming from the decomposition of the carbon-containing activator.

Second, porosity formation was investigated and optimized. The role of the foaming agent (FA) in the phase and microstructure formation, as well as porosity was studied. For this purpose the influence of three relevant parameters was studied: synthesis pressure, reagents ratio and FA concentration. The optimum parameters of synthesis were set up, and the density, porosity (open and closed) and wall thickness were evaluated. It was shown that depending on both the TiAl ratio and the FA amount, as well as synthesis pressure, different porosity was achieved. The optimization of these parameters leads to samples with a controlled porosity. Moreover, only controlling the synthesis pressure, samples with homogenous porosity can be obtained for a wide range of compositions (TiAl ratio and FA concentration).