A MODELING INVESTIGATION INTO THE SHAPE, SIZE & PURITY CONTROL OF COMBUSTION SYNTHESIZED INTERMETALLIC POWDERS

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ABSTRACT

A variant of the SHS process, termed the PSHS process, has recently been developed and has demonstrated the capability to produce a wide range of intermetallic compounds ranging from binary intermetallics such as TiAl, NiAl, $MoSi_2$ etc., to ternary intermetallics such as $Ti(Al,Mn)_3$ and quaternary intermetallics such as Fe_3AlCr-B. An understanding of the factors that affect the product characteristics such as particle size, morphology and phase purity will help develop this process as a viable alternative to conventional powder manufacturing technologies. This paper presents the effect of process parameters on the particle size of the two binary intermetallics, NiAl and TiAl, synthesized by the PSHS process. The experimental results indicate that unlike NiAl which has been suggested to form by precipitation from a liquid phase, Ti-48Al probably forms by a diffusion controlled process. A reaction engineering model capable of predicting the phase distributions during the PSHS of TiAl, suggests a time dependent homogenization of the intermetallic phase. The model's predictions correlate well with experimental results. This clearly indicates that the different aluminides, despite similar reaction initiation conditions, form by very different mechanisms.

1. INTRODUCTION

Combustion synthesis, also termed Self-Propagating High Temperature synthesis (SHS), is a novel and simple method for making certain high temperature materials such as ceramics and intermetallics[1]. A variant of this process, termed the Plasma Initiated Self-Propagating High Temperature Synthesis (PSHS) process, has recently been demonstrated to produce a wide range of intermetallics ranging from binary intermetallics such as NiAl, TiAl, NiTi etc. to ternary intermetallics such as $Ti(Al,Mn)_3$, Ti-24Al-11Nb, and