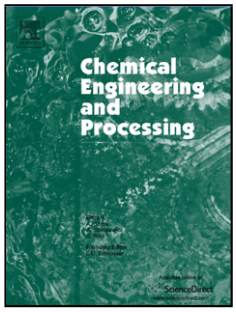

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MICROWAVE PROCESSING OF HIGH ENTROPY ALLOYS: A POWDER METALLURGY APPROACH

P. Veronesi[(1)], E. Colombini[(1)], R Rosa[(1)], C. Leonelli[(1)] and M. Garuti[(2)]

[(1)] Dept of Engineering "Enzo Ferrari", University of Modena and Reggio Emilia, Italy

[(2)] MKS, Alter Products, Via P. e M. Curie, 8, 42122 Reggio Emilia, Italy

Research Highlights:

- Innovative near net shape technology to synthesize high entropy alloys
- Excess Al favors microwave synthesis and homogenization in FeNiCoCrAl system
- Comparison between microwave heating, mechanical alloying and conventional furnace
- Best efficiency of microwave synthesis at ISM frequency of 2.45 GHz and 5.8 GHz
- Microwaves required the shortest time and lowest specific energy consumption

ABSTRACT

Microwaves at the ISM frequency of 2450 and 5800 MHz have been exploited to prepare FeCoNiCrAl-family high entropy alloys by direct heating of pressed mixtures of metal powders. The aim of this work is to explore a new microwave assisted near-net-shape technology, using powder metallurgy approach for the preparation of high entropy alloys, able to overcome the limits of current melting technologies (defects formation) or solid state ones (time demanding). Results show that direct microwave heating of the powder precursors occurs, and further heating generation is favored by the ignition of exothermal reactions in the compound. Microwave processing, exploited both for the ignition and sustaining of such reactions, has been compared to reactive sintering in laboratory furnace and mechanical alloying in a planetary ball milling. Results demonstrate that microwave required the shortest time and lowest energy consumption, thus it is promising time- and cost-saving synthetic route.

Keywords: microwave ignition, combustion synthesis, powder metallurgy

INTRODUCTION

High-entropy alloys (HEA) are a class of multi-component alloys composed of 5 or more principal constituent elements and each with a concentration between 5 and 35 atomic % [1].