Fe-Sn Intermetallic Compound Synthesized via Mechanical Alloying and Liquid Phase Sintering

Nattaya Tosangthum[1], Pinya Meesa-Ard[2] and Ruangdaj Tongsri[1*]

[1]Powder Metallurgy Research and Development Unit, Thailand National Metal and Materials Technology Center, Pathum Thani 12120, Thailand
[2]Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand

[*]Corresponding author. E-mail: ruangdt@mtec.or.th

https://doi.org/10.12982/CMUJNS.2017.0019

ABSTRACT

This investigation aimed to synthesize an iron (Fe)-tin (Sn) intermetallic compound ($FeSn_2$) by using a two-step process of mechanical alloying (MA) and liquid phase sintering (LPS). We demonstrated experimentally that this process was able to produce the $FeSn_2$ intermetallic compound. Two different mechanical alloying procedures for producing mechanically alloyed Fe-Sn powders were explored. In the first, mixtures of as-recieved Fe and Sn powders were mechanically alloyed. In the second, the as-received Fe powder was pre-milled first and the as-received Sn powder was then added and mechanically alloyed. Under the same liquid phase sintering conditions, the sintered materials produced via the first mechanical alloying procedure showed that the $FeSn_2$ content increased with increasing sintering time and left small traces of unreacted Fe and Sn materials. In the sintered materials produced via the second mechanical alloying procedure, only the $FeSn_2$ phase was observed for all sintering times. The two-step process using the second mechanical alloying procedure performed better; it synthesized more of the $FeSn_2$ intermetallic compound.

Keywords: Powder metallurgy, Mechanical alloying, Liquid phase sintering, Fe-Sn intermetallic compounds

INTRODUCTION

Transition metal (TM)-tin (Sn) based intermetallic compounds are new active materials used as energy storage components for electrochemical anode structures, due to their delivered capacity and cycling stability. Energy storage devices, or batteries, especially rechargeable lithium-ion batteries (LIBs), are important power sources for various commodities such as portable electronic devices, plug-in hybrid electric vehicles, and all-electric vehicles (Chen, 2013). In addition, intermetallic compounds, such as Sn-Ni alloys, Sn-Co alloys, Sn-Cu alloys, and Sn-Fe alloys, are employed to solve the volume expansion problem