Accepted Manuscript

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PII: S0925-8388(18)32758-0

DOI: 10.1016/j.jallcom.2018.07.257

Reference: JALCOM 46973

To appear in: *Journal of Alloys and Compounds*

Received Date: 1 August 2017

Revised Date: 30 June 2018

Accepted Date: 23 July 2018

Please cite this article as: C. Echevarria-Bonet, N. Iglesias, J.S. Garitaonandía, D. Salazar, G.C. Hadjipanayis, J.M. Barandiaran, Structural and magnetic properties of hexagonal Fe_3Sn prepared by non-equilibrium techniques, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.07.257.

Structural and magnetic properties of hexagonal Fe_3Sn prepared by non-equilibrium techniques

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Abstract

We report a thorough structural and magnetic study of Fe_3Sn produced either by solid state reaction or by mechanical alloying in order to figure out which of the two techniques is most suitable for obtaining the purest Fe_3Sn alloy. Solid state reaction of Fe and Sn starting powders results in a pure sample (100%) of Fe_3Sn. The extraordinary purity and crystallinity have been confirmed by in-lab XRD and Mössbauer spectroscopy. This study has been completed by magnetic measurements M(H) and M(T); a saturation magnetization of 122 $A{\cdot}m^2/kg$ and Curie temperature T_c = 475ºC, have been obtained.

Keywords: permanent magnets, solid state reactions, mechanical alloying, magnetic measurements, XRD, Mössbauer spectroscopy

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1. Introduction

During the last century, the intense research on hard magnetic materials led to a continuous increase of permanent magnets (PM) development. The current PM markets consists mostly of inexpensive ferrites with moderate performance used in small motors or electronic components to high performance and expensive rare-earth (RE) magnets like $Nd_2Fe_{14}B$ and $SmCo_7$ used in large motors, generators and magnetic resonance imaging equipment among others.

The stored energy of a PM is given by its energy product (BH) (B the induction), so that a large (BH) value is desirable in working conditions. In fact, the maximum energy product $(BH)_{max}$ that a PM can provide is its figure of merit. Other important properties that define a PM are the