Effect of Cr to Fe on the Solid Solubility, Lattice Parameter and Strain Fabrication of $Fe_{80}Cr_{20}$ Alloy Powder

Dafit Feriyanto[1,a], M. I. Idris[1b], Darwin Sebayang[2,c]
[1] Faculty of Mechanical and Manufacturing Engineering, University Tun Hussein Onn Malaysia (UTHM), Parit Raja, BatuPahat, 86400 Johor, Malaysia
[2] Faculty of Engineering Technology, University Tun Hussein Onn Malaysia (UTHM), Parit Raja, BatuPahat, 86400 Johor, Malaysia

Email: [a]dafitferiyanto@yahoo.co.id, [b]izwana@uthm.edu.my, [c]d_sebayang@hotmail.com

Abstract
This paper focuses on the effect of the new method on the crystallite size and thermal stability of $Fe_{80}Cr_{20}$ alloy powder. Generally, the ball milling sample and ultrasonic technique sample have dissatisfaction result when applied at high temperature. In addition, the combination both of those techniques not yet carried out. The new method of mechanical alloying and ultrasonic technique were applied in order to reduce the crystallite size. The new method is called as combination treatment. This condition allows the enhancement of thermal stability of $Fe_{80}Cr_{20}$ alloy powder. In this study, mechanical alloying process was carried out with milling time of 60 hours. Then, the ultrasonic technique was performed at frequency of 35 kHz at 3, 3.5, 4, 4.5, and 5 hours. From XRD analysis, it was found that the broader peaks indicated the smaller crystallite size. It shows that the combination treatment (milled and UT) reduce the crystallite size up to 2.171 nm when mechanically alloyed for 60 hours (milled 60 h) and followed by ultrasonic treatment for 4.5 hours (UT 4.5 h). Smallest crystallite size enhance the thermal stability up to 12.7 mg which shown by TGA analysis during 1100 ^{0}C temperature operation. The combination treatment is method which is effective to fabricate $Fe_{80}Cr_{20}$ alloy powder.
Keywords; crystallite size, thermal stability, mechanical alloying, ultrasonic technique and interconnect

Introduction
The iron-chromium system has been used for high-strength, thermal stability and corrosion-resistant applications [1,2]. According to [3,9] that the crystallite size of metallic material is decreased with the thermal stability increased. Developing nanocrystallite metallic interconnects also studied by [4]. Higher thermal stability/oxidation resistance shown by smaller mass gain during temperature operation. Intermetallic $Fe_{80}Cr_{20}$ developed by using mechanical alloying [7]. FeCrAl is treated using ultrasonic technique [8,9]. Ball milling and ultrasonic technique is shown inconvenience results at high temperature operation [3-11]. Therefore, this study will combine between ball milling and ultrasonic technique.

Experimental Method
Raw materials are mixed at 80 wt% Fe and 20 wt% Cr compositions. In this research the synthesis was milling combined with ultrasonic treatment. Characterization phase using X-Ray Diffraction (XRD) and Thermo Gravimetric Analysis (TGA).

Result and Discussion
XRD Peaks
Generally the combination treatment samples are broader than raw material, UT samples and milled 60 h sample. Broader peaks are indicated that the smaller crystallite size. The peaks are located at the reflection angle of 44^0, 65^0 and 82^0.

Crystallite Size And Strain Analysis

The combination treatment has a significant effect to reduce the crystallite size.

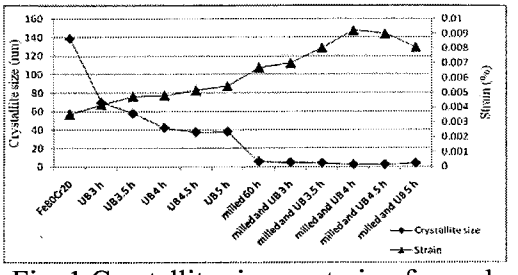

Fig. 1 Crystallite size vs strain of sample designation

Crystallite size had decreased approximately 61% which compared with milled 60 h samples, 81% compared with UT samples and 98 % compared with raw material.

Thermal Stability Analysis

The mass gain of the combination treatment samples have reduced approximately of 52 % which compared with raw material, 47 % which compared with UT samples and 25% compared with milled 60 h sample.

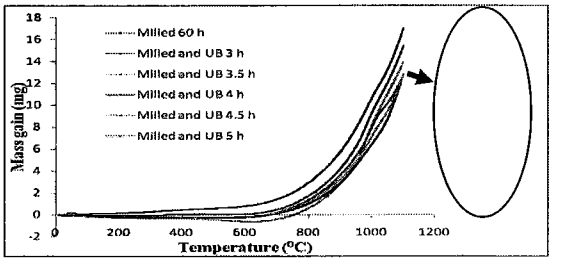

Fig. 2 Mass gain of milled 60 hours and combination treatment samples

Conclusion

The influence of the crystallite size on the thermal stability of the metallic interconnect from literature may result from differences in the method, composition and temperature operation. It was found that this results obtained by new method are consistent.

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