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MULTI-SCALE STRUCTURE INVESTIGATIONS OF MAGNESIUM ALLOYS BY XAFS-CT

S. Yoshioka [*1,2], M. Ishida[1], K. Yasuda[1], S. Matsumura[1,2], S. Kimura[3], Y. Takeichi[4], Y. Niwa[4], & M. Kimura[4]

[1]Faculty of Engineering, Kyushu University, Fukuoka 819-0395, Japan
[2]Research Center for Synchrotron Light Applications, Kyushu University, Kasuga, 816-8580, Japan
[3]Japan Synchrotron Radiation Research Institute (JASRI/SPring-8), Hyogo 679-5198, Japan
[4]Photon Factory, Institute of Materials Structure Science, High Energy Accelerator Research Organization (KEK), Tsukuba 305-0801, Japan

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Summary: Magnesium based alloys in Mg-Zn-Gd system have many crystal structures and morphologies depending on aging temperatures and holding times. The local structures around Zn were investigated by x-ray absorption fine structure combined with x-ray computed tomography.

1. INTRODUCTION

Magnesium based alloys in Mg-Zn-Gd with long period stacking ordered (LPSO) structure have superior mechanical properties. The specific structure is formed by the aging procedure at high temperature (< 350 ˚C). Additionally, this system has many crystal structures and morphologies depending on aging temperatures and holding times [1, 2]. In this study, our final goal is to determine the local structure behaviors around Zn and Gd on precipitation process of LPSO phase from $Mg_{97}Zn_1Gd_2$ cast alloy. We adopt x-ray absorption fine structure (XAFS) method combined with x-ray computed tomography (X-CT).

2. EXPERIMENTAL METHOD

Alloy ingots of $Mg_{97}Zn_1Gd_2$ were prepared by high-frequency induction heating in an argon atmosphere. Solution treatment was carried out at 793 K for 2 h in air. The specimens were quenched in water at room temperature. The annealing procedure were carried out using with electric furnaces in air. XAFS-CT measurements were performed on undulator beamline 37XU of SPring-8, Japan. X-rays from an undulator were monochromatized by Si(111) double crystal monochromator. The beam size at sample positon is ~1 mm^2. Transmitted image sets for 3D tomographic reconstructions were acquired with 40 incident x-ray energy points around Zn *K*-edge for x-ray absorption near edge structure (XANES) spectra.

3. RESULTS

Figure 1 shows XAFS-CT results of the sample annealed at 480 ˚C for 24 hours. As shown in Fig. 1(a), the LPSO particles (colored green) with several 10 μm were distributed in α-Mg phase (transparent). Moreover, fig. 1(b) shows the XANES spectrum, plotted the liner absorption coefficient of the LPSO region in the CT stack images. The fine structures of Zn *K*-edge spectrum were clearly detected. The XANES spectrum was different from that of the sample annealed at 300 ˚C for 10 hours.

References

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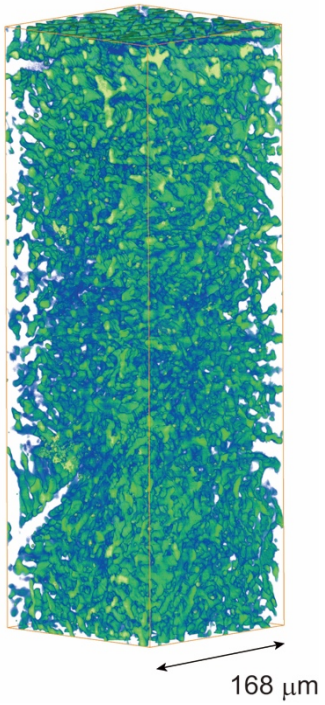
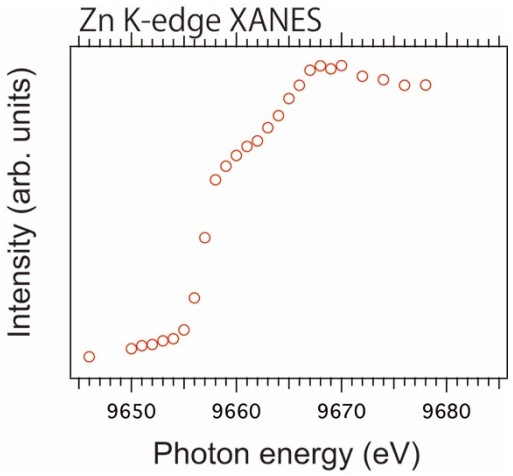
* e-mail: syoshioka@nucl.kyushu-u.ac.jp



(a)



(b)

Figure 1: XAFS-CT of the sample annealed at 480 ˚C for 24 hours. (a) 3D rendered image. (b) Zn K-edge XANES.