Erratum to: Anisotropic Diffusion Behavior of Al in Mg: Diffusion Couple Study Using Mg Single Crystal

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IN the calculation of the interdiffusion coefficients of two intermediate phases and the impurity diffusion coefficients of Al in hcp Mg, a small numerical error was found. The error does not change the main conclusions of the work but can lead to small errors in the diffusion calculations. The following is a revision of the interdiffusion coefficients and impurity diffusion coefficient. The numbering of figures, tables and references used in this erratum are the same as the original paper for convenience.

Interdiffusion coefficients for two intermediate phases ($\text{Mg}_{17}\text{Al}_{12}$ and Mg_2Al_3) were calculated using the Heuman-Matano method^[13] by identifying the Matano plane from Al concentration profile throughout the whole diffusion zone quantified by Electron Probe Micro Analyzer (EPMA). For example, the position of the Matano plane for the sample annealed after 72 hours at 693 K (420 °C) is marked in Figure 1. The revised interdiffusion coefficients for the $\text{Mg}_{17}\text{Al}_{12}$ and Mg_2Al_3 intermediate phases are presented in Table III and in Figure 4 with comparison to previous studies.^[5,8] Our results are in good agreement with Brennan *et al.*^[8]

The revised values for the Al impurity diffusion coefficient in hcp Mg from the multiphase diffusion

calculation used in the original paper are plotted in Figure 7(a). In order to confirm the impurity diffusion, a Gaussian solution of Fick's second law^[29] is also applied to analytically calculate impurity diffusion coefficient in this erratum. In the analytical method, the impurity diffusion coefficient for each sample was calculated from the slope of $\ln(\text{Al concentration})$ vs square of penetration distance in dilute Al concentration region of hcp Mg solid solution. As can be seen in Figure 7(a), the analytical results are in good agreement with the results obtained from multiphase diffusion simulation. The revised Al impurity diffusion coefficients, depending on the orientation of hcp Mg, were plotted in Figure 7(b) and compared with previous studies.^[4,7,9] The revised optimized mobilities of Al in hcp Mg along the *a*- and *c*-axis of Mg crystal are

$$\begin{aligned}\Omega_{\perp\text{Al}}(\text{hcp Mg}) &= 3.23 \times 10^{-7} \exp(-148955/RT) \\ \Omega_{\parallel\text{Al}}(\text{hcp Mg}) &= 6.32 \times 10^{-7} \exp(-153947/RT)\end{aligned}\quad [10]$$

The impurity diffusion coefficient values for Al in hcp Mg from the present experimental study are

$$\begin{aligned}D_{\perp\text{Al}} &= 4.86 \times 10^{-3} \exp(-154484/RT) \\ D_{\parallel\text{Al}} &= 9.51 \times 10^{-3} \exp(-159476/RT)\end{aligned}\quad [11]$$

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Fig. 1—Diffusion couple experiment with single crystal Mg: (a) Interface microstructure of diffusion couple (SEM BSE image) after 72 h annealing at 693 K (420 °C), (b) Al concentration profile (WDS line scan) through the interface with the Matano plane.

Table III. Interdiffusion Coefficients for $Mg_{17}Al_{12}$ and Mg_2Al_3 Phases from the Present Study in Comparison to the Previous Studies^[5,8]

Orientation	$Mg_{17}Al_{12}$		Mg_2Al_3		Reference
	D_o (m^2/s)	Q (kJ)	D_o (m^2/s)	Q (kJ)	
<i>a</i> -axis	$3.59 (\pm 0.82) \times 10^{-5}$	109.9396 (± 2.18)	$2.96 (\pm 1.69) \times 10^{-6}$	78.9177 (± 8.43)	present Study
<i>c</i> -axis	$2.89 (\pm 0.59) \times 10^{-5}$	109.2949 (± 3.13)	$1.55 (\pm 0.31) \times 10^{-6}$	76.2443 (± 2.37)	
Polycrystalline	1.8×10^{-3}	129.7	9.6×10^{-6}	84.8	Brenann <i>et al.</i> ^[8] Funamizu and Watanabe ^[5]
Polycrystalline	$9.9 (+11.9; -5.4) \times 10^{-5}$	117.57 (± 4.18)	$2.4 (+3.3; -1.4) \times 10^{-8}$	56.90 (± 4.60)

(a)

(b)

Fig. 4—Variation of the inter-diffusion coefficients of intermediate phases: (a) $\text{Mg}_{17}\text{Al}_{12}$ phase, (b) Mg_2Al_3 phase with temperature in comparison to the previous studies.^[5,8]

The present activation energies of the diffusion of Al in hcp Mg along the a - and c -axis are 154.48 ± 3.86 kJ/mol and 159.48 ± 2.45 kJ/mol, respectively.

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(a)

(b)

Fig. 7—Variation of Al impurity diffusion coefficients in hcp Mg along its a - and c -axis directions with temperature. (a) Present results from single crystal diffusion experiment (model and analytical represent the calculations by multiphase diffusion simulation and analytical method, respectively), and (b) comparison with the previous data derived from polycrystalline samples^[4,7] and the first principles calculations.^[9]

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