**Electronic Supporting Information for:**

# On the vacancy-controlled dealloying of rapidly solidified Mg-Ag alloys

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## Experimental procedure:

Mg-Ag alloys with nominal compositions of $Mg_{65}Ag_{35}$, $Mg_{62}Ag_{38}$, $Mg_{58}Ag_{42}$, $Mg_{54}Ag_{46}$, and $Mg_{50}Ag_{50}$ (at.%) were prepared from pure Mg (99.9 wt.%) and pure Ag (99.9 wt.%) in a quartz crucible using a high-frequency induction furnace in an argon atmosphere. Using a single roller melt spinning apparatus, the prealloyed ingots were remelted in a quartz tube by high-frequency induction heating and then rapidly solidified onto a copper roller at a circumferential speed of ~ 18 m $s^{-1}$.

The dealloying of the $Mg_{65}Ag_{35}$ and $Mg_{62}Ag_{38}$ ribbons was firstly performed in the 1 wt. % HCl solution at room temperature. Then the dealloying was continuously carried out in the same solution at 90 ± 5 °C in order to further leach out the residual Mg in the samples. In comparison, no bubbles emerged when the $Mg_{58}Ag_{42}$ and $Mg_{54}Ag_{46}$ ribbons were immerged in the 1 wt. % HCl solution at room temperature. Thus the dealloying of the $Mg_{58}Ag_{42}$ and $Mg_{54}Ag_{46}$ alloy was directly carried out at 90 ± 5 °C. It is astonishing that the $Mg_{50}Ag_{50}$ alloy cannot be dealloyed even in the 10 wt.% HCl solution at 90 ± 5 °C.

Microstructural characterization of the rapidly solidified Mg-Ag alloys and as-dealloyed samples was performed using X-ray diffraction (XRD, Hitachi Rigaku D/max-RB) with Cu Kα radiation, scanning electron microscopy (SEM, LEO 1530VP), and X-ray photoelectron spectroscopy (XPS, ESCALAB 250) using monochromatic Al Kα radiation.

## Electrochemical measurements:

Electrochemical measurements were performed in a standard three-electrode cell using an LK 2500A Potentiostat. A 1 M NaCl aqueous solution was chosen as electrolyte to avoid the interference of chemical dealloying. The Mg-Ag ribbons were directly used as the working electrode. The counter electrode was a Pt plate, while the reference electrode was a saturated calomel electrode (SCE). Prior to electrochemical measurements, the electrolytes were deaerated by bubbling with $N_2$ for 10 min.

# Figures and Tables:

**Table E1** Lattice parameter (nm) of different Mg-Ag alloys calculated using the Bragg Equation with different crystal planes.

| crystal plane / alloy composition | (100) | (110) | (111) | (200) | (210) | (211) | average |
|---|---|---|---|---|---|---|---|
| $Mg_{65}Ag_{35}$ | 0.3341 | 0.3344 | 0.3345 | 0.3344 | 0.3341 | 0.3343 | 0.3343 |
| $Mg_{62}Ag_{38}$ | 0.3339 | 0.3338 | 0.3338 | 0.3340 | 0.3340 | 0.3339 | 0.3339 |
| $Mg_{58}Ag_{42}$ | 0.3321 | 0.3316 | 0.3323 | 0.3324 | 0.3324 | 0.3324 | 0.3322 |
| $Mg_{54}Ag_{46}$ | 0.3311 | 0.3314 | 0.3310 | 0.3313 | 0.3311 | 0.3312 | 0.3312 |
| $Mg_{50}Ag_{50}$ | 0.3302 | 0.3302 | 0.3303 | 0.3305 | 0.3305 | 0.3306 | 0.3304 |

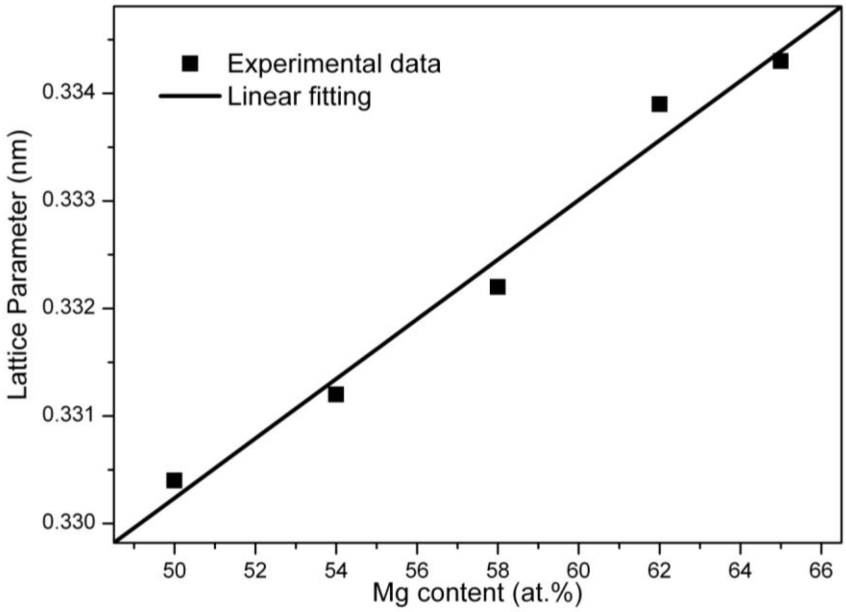


**Fig. E1** Plot of lattice parameter vs. Mg content in the rapidly solidified Mg-Ag alloys.

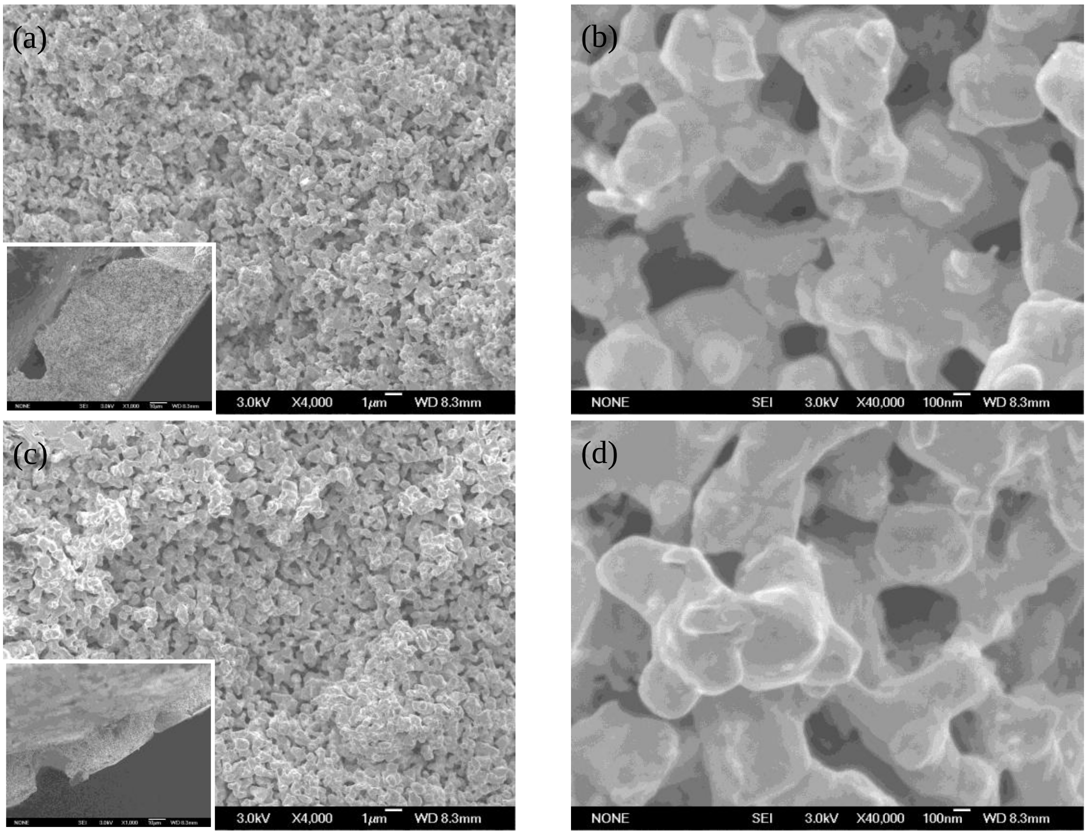


**Fig. E2** The SEM micrographs showing the section-view microstructure of the np-Ag by dealloying (a, b) $Mg_{62}Ag_{38}$ and (c, d) $Mg_{54}Ag_{46}$ alloys in the 1 wt.% HCl solution.

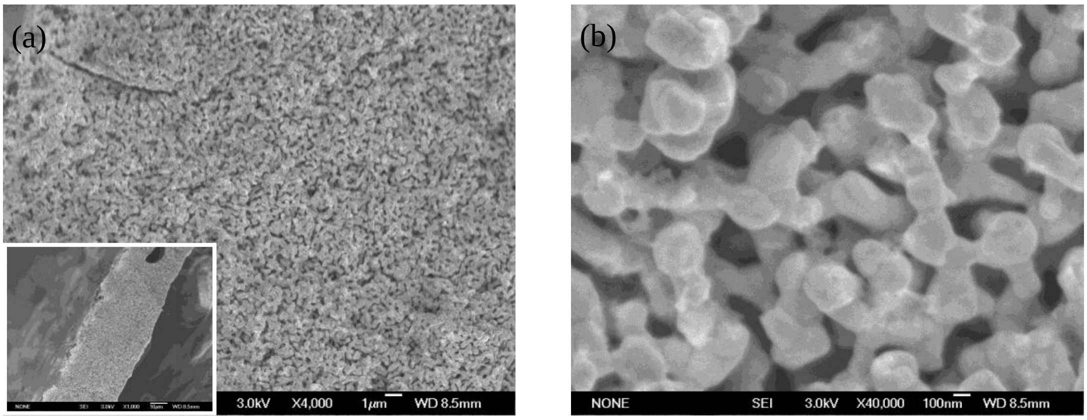


**Fig. E3** The SEM micrographs showing the section-view microstructure of the np-Ag by dealloying the $Mg_{65}Ag_{35}$ alloy in the 1 wt.% HCl solution for 600 min.

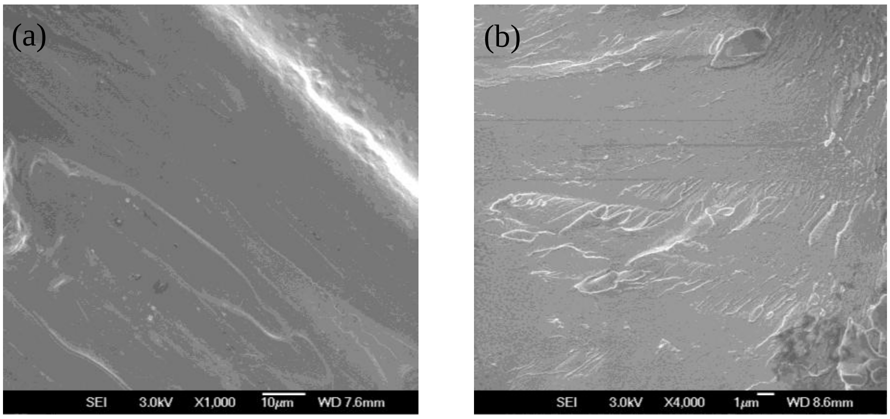


**Fig. E4** The SEM micrographs showing the (a) surface-view and (b) section-view microstructure of the rapidly solidified $Mg_{65}Ag_{35}$ alloy.

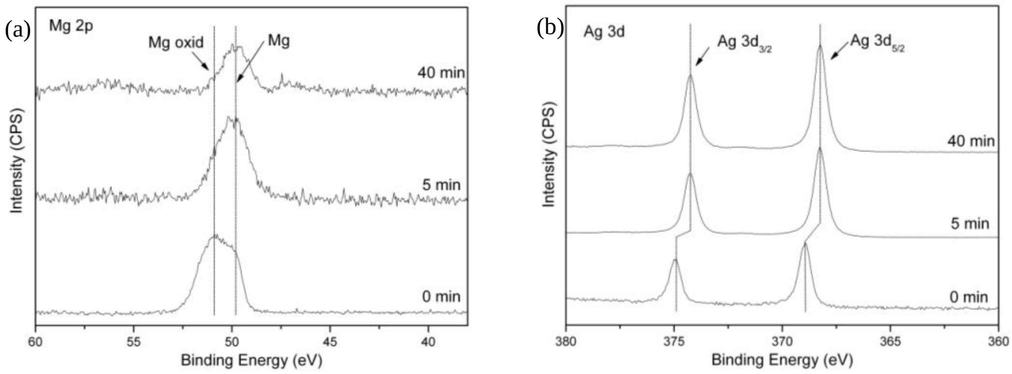


**Fig. E5** (a) Mg 2p and (b) Ag 3d XPS spectra of the $Mg_{65}Ag_{35}$ alloy dealloyed in the 1 wt.% HCl solution for 0, 5, and 40 min.

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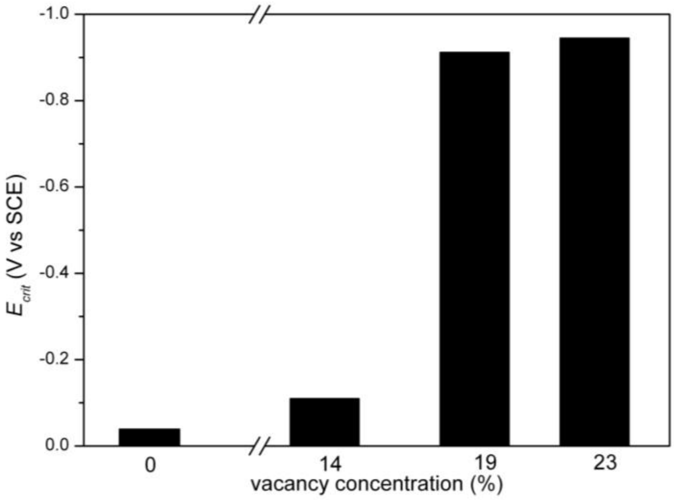


**Fig. E6** The histogram of $E_{crit}$ vs. vacancy concentration for the rapidly solidified Mg-Ag alloys.