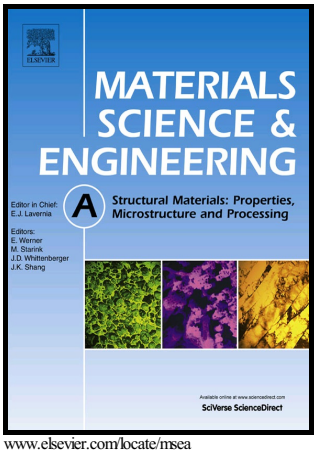
Dislocation binding as an origin for the improvement of room temperature ductility in Mg alloys

Ki-Hyun Kim, Ji Hyun Hwang, Hyo-Sun Jang, Jong Bae Jeon, Nack Joon Kim, Byeong-Joo Lee



www.elsevier.com/locate/msea

PII: S0921-5093(18)30011-X
DOI: https://doi.org/10.1016/j.msea.2018.01.010
Reference: MSA35964

To appear in: *Materials Science & Engineering A*

Received date: 13 November 2017
Revised date: 2 January 2018
Accepted date: 3 January 2018

Cite this article as: Ki-Hyun Kim, Ji Hyun Hwang, Hyo-Sun Jang, Jong Bae Jeon, Nack Joon Kim and Byeong-Joo Lee, Dislocation binding as an origin for the improvement of room temperature ductility in Mg alloys, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.01.010

Dislocation binding as an origin for the improvement of room temperature ductility in Mg alloys

Ki-Hyun Kim[1 +], Ji Hyun Hwang[2 +], Hyo-Sun Jang[1], Jong Bae Jeon[3], Nack Joon Kim[2*] and Byeong-Joo Lee[1*]

[1] Department of Materials Science and Engineering,
Pohang University of Science and Technology (POSTECH), Pohang 37673, Republic of Korea

[2] Graduate Institute of Ferrous Technology,
Pohang University of Science and Technology (POSTECH), Pohang 37673, Republic of Korea

[3] Functional Component and Materials R&D Group,
Korea Institute of Industrial Technology (KITECH), Busan 46749, Republic of Korea

Abstract

Improving room temperature ductility and formability is a bottleneck for a wide industrial application of Mg alloys, but even the mechanism for the effect of alloying elements on the deformation behavior of Mg is not clearly known. Here, using a molecular dynamics simulation, we clarify the role of alloying elements in improving the room temperature ductility of Mg alloys: Solute atoms have stronger dislocation binding tendency and solid solution strengthening effect on basal <a> slip planes than on non-basal <c+a> slip planes, reduce the anisotropy in the critical resolved shear stress between slip systems, and eventually improves the room temperature ductility. We predict that any solute elements with a size difference from Mg can improve the room temperature ductility, once the alloying amount is carefully controlled. By proving the validity of the prediction experimentally, we provide a new guide for designing Mg alloys with improved room temperature ductility and formability.

[+] Equal contribution

* Co-corresponding author: N.J. Kim (njkim@postech.ac.kr), B.-J. Lee (calphad@postech.ac.kr)