*ICCES, 2023, vol.25, no.2*
Tech Science Press
DOI: 10.32604/icces.2023.09981

PROCEEDINGS

# Mechanism of Strain Hardening Of Magnesium Single-Crystals: Discrete Dislocation Dynamics Simulations

**Mao Li[1], Xiaobao Tian[1], Wentao Jiang[1], Qingyuan Wang[1], Haidong Fan[1,*]**

[1]Department of Mechanics, Sichuan University, Chengdu, 610065, China
[*]Corresponding Author: Haidong Fan. Email: hfan85@scu.edu.cn

**ABSTRACT**
Poor ductility heavily limits the industrial application of magnesium (Mg) alloys, and pyramidal dislocations are an important deformation mode for ductility enhancement. In this work, discrete dislocation dynamics (DDD) simulations were performed to study the mechanical behavior and dislocation evolution of Mg single-crystals compressed along c-axis. Especially, basal-transition and cross-slip algorithms of pyramidal <c+a> dislocations were proposed and introduced in the DDD method. Simulation results show that basal-transition is an important mechanism for the strong strain hardening observed during c-axis compression of Mg single-crystals. Since the basal-transition events are thermally activated, increasing temperature leads to a high strain hardening rate. During the deformation, the <c+a> dislocations on first-order pyramidal planes mostly cross slip onto second-order pyramidal planes and few are transited onto basal planes, while <c+a> dislocations on second-order pyramidal planes are mostly transited onto basal planes directly. In addition, the basal-transition behavior is an important reason for the formation of dislocation loops and dislocation steps observed in experiments. The current work provides new mechanisms for the pyramidal dislocations, which are significant for understanding the behaviors of pyramidal dislocations and ductility enhancement of Mg alloys.

**KEYWORDS**
Dislocations; magnesium; dynamics; strengthening and mechanisms; crystal plasticity

**Funding Statement:** The author(s) received no specific funding for this study.

**Conflicts of Interest:** The authors declare that they have no conflicts of interest to report regarding the present study.