World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:16, No:03, 2022

# Microscopic and Mesoscopic Deformation Behaviors of Mg-2Gd Alloy with or without Li Addition

**Authors :** Jing Li, Li Jin, Fulin Wang, Jie Dong, Wenjiang Ding

**Abstract :** Mg-Li dual-phase alloy exhibits better combination of yield strength and elongation than the Mg single-phase alloy. To exploit its deformation behavior, the deformation mechanisms of Mg-2Gd alloy with or without Li addition, i.e., Mg-6Li-2Gd and Mg-2Gd alloy, have been studied at both microscale and mesoscale. EBSD-assisted slip trace, twin trace, and texture evolution analysis show that the α-Mg phase of Mg-6Li-2Gd alloy exhibits different microscopic deformation mechanisms with the Mg-2Gd alloy, i.e., mainly prismatic <a> slip in the former one, while basal slip, prismatic <a> slip and extension twin in the latter one. Further Schmid factor analysis results attribute this different intra-phase deformation mechanisms to the higher critical resolved shear stress (CRSS) value of extension twin and lower ratio of CRSSprismatic /CRSSbasal in the α-Mg phase of Mg-6Li-2Gd alloy. Additionally, Li addition can induce dual-phase microstructure in the Mg-6Li-2Gd alloy, leading to the formation of hetero-deformation induced (HDI) stress at the mesoscale. This can be evidenced by the hysteresis loops appearing during the loading-unloading-reloading (LUR) tensile tests and the activation of multiple slip activity in the α-Mg phase neighboring β-Li phase. The Mg-6Li-2Gd alloy shows higher yield strength is due to the harder α-Mg phase arising from solid solution hardening of Li addition, as well asthe strengthening of soft β-Li phase by the HDI stress during yield stage. Since the strain hardening rate of Mg-6Li-2Gd alloy is lower than that of Mg-2Gd alloy after ~2% strain, which is partly due to the weak contribution of HDI stress, Mg-6Li-2Gd alloy shows no obvious increase of uniform elongation than the Mg-2Gd alloy.But since the β-Li phase is effective in blunting the crack tips, the Mg-6Li-2Gd alloy shows ununiform elongation, which, thus, leads to the higher total elongation than the Mg-2Gd alloy.

**Keywords :** Mg-Li-Gd dual-phase alloy, phase boundary, HDI stress, dislocation slip activity, mechanical properties
**Conference Title :** ICMAA 2022 : International Conference on Magnesium Alloys and Applications
**Conference Location :** Prague, Czechia
**Conference Dates :** March 21-22, 2022