

Geometrical aspects of strengthening by kink band and its aggregate

Kink deformation is a rare plastic deformation mode that occurs in materials with very limited number of slip systems. In recent years, magnesium alloys with a long-period stacking-ordered structure have been discovered and are attracting attention as next-generation lightweight structural materials that surpass high strength Al alloys. Interestingly, the plastic deformation of this alloy is mainly caused by kink deformation, and the strength becomes abnormally high when a large amount of kink band is formed by forging. The origin of this strengthening has not been clarified yet. This study analyzes the geometry of kink deformation and kink microstructure based on the rank-1 connection, and clarifies the geometric factors of the strengthening mechanism. We show the possibility that two phenomena, formation of disclination and cooperative dragging of grain boundary, which are not focused in the conventional theory of strengthening of metals, play decisive roles in the abnormal strengthening.