Simultaneous enhancement of strength and ductility in ultrafine grained Al-Mg alloy by high-pressure sliding

Yongpeng Tang
tayopeng@gmail.com

Abstract:

Ultrafine grained (UFG) Al alloys produced by severe plastic deformation (SPD) have high strength but low ductility, which limits the technological applications of UFG Al alloys. Various strategies to improve low ductility of the UFG Al alloys have been proposed, which mainly are fabricating bi-modal microstructures, increasing the value of stra,in-rate sensitivity, deforming at high strain rates and/or low temperatures. For the age-hardenable Al alloys, introducing a fine dispersion of nanosized precipitates within the grain interior has been suggested to be a way to improve the strength and ductility simultaneously.

In this study, aging behavior, mechanical properties and microstructures of a severely-deformed Al-13.4wt%Mg alloy were investigated by Vickers microhardness test, tensile test, and transmission electron microscopy (TEM). The combined processing of high-pressure sliding (HPS) and aging treatment at 373 K for 1210 ks resulted in a hardness as high as HV222 with an age hardening by HV12±2. After aging treatment, ultimate tensile strength and elongation to failure reached 688 MPa and 11%, greater than those of the HPS-processed specimen without aging treatment (i.e., 664 MPa and 5%). The corresponding TEM microstructures suggested that the modulated structures formed by spinodal decomposition are responsible not only for the higher hardness and strength but also for the better strength–ductility balance. This study demonstrates that the spinodal decomposition is a convincing approach to achieve simultaneous enhancement of strength and ductility in ultrafine grained aluminum alloy decomposed by spinodal decomposition.