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Microstructural Investigation of Al-Mg/B_4C Composite deformed at elevated temperature

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Abstract

The microstructure evolution of Al-3wt.%Mg reinforced with 10 vol.% B_4C during isothermal compression at temperatures ranging 300 to 500 $^{\circ}$C at strain rates of 0.001 to 10 s^{-1} was investigated by electron backscatter diffraction (EBSD). According to the results, at strain rates lower than 0.01 s^{-1} and temperatures higher than 400 $^{\circ}$C, the grain size distribution in the microstructure is uniform, dynamic recovery is the predominant softening mechanism and continues recrystallization through lattice rotation is responsible for grain refinement. However, during deformation at higher strain rates or lower temperatures, deformation zones appeared in special locations around particles where microstructure is formed by recovered and hardened grains, and particle stimulating nucleation leaded to partially discontinues dynamic recrystallization which in turns promoted finer average grain and sub-grain size than those in single phase Al-Mg alloy. Moreover, it was found that the variation of grain and sub-grain size with deformation parameters (Zener-Holloman parameter (Z)) can be described by a power law type equation rather than by an initially expected exponential expression.

Keywords: Hot deformation; Al-Mg alloy; Metal Matrix Composite; Electron Back Scatter Diffraction; Dynamic restoration