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Ultra-high strengthening efficiency of graphene nanoplatelets reinforced magnesium matrix composites

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Abstract:

Homogeneous magnesium alloy (ZK60) reinforced by low content of graphene nanoplatelets (GNPs) was fabricated by facile melt stirring and hot extrusion processes with cost effectiveness. GNPs were pre-dispersed with Mg powder and extruded into rods used as precursor for melting, which effectively guaranteed the integrity and dispersion of GNPs. In composites, GNPs closely combined with the magnesium matrix in nanoscale. Compared with ZK60 alloy, the composite with only 0.05 wt.% GNPs can perform 62% enhancement in yield strength up to 256 MPa, exhibiting an ultra-high strengthening efficiency of 1550. Based on theoretical analysis, load transfer of GNPs contributed most (~72%) to the strength improvement of GNP/ZK60 composite, due to the 2D interfacial contacting and continuous combination of GNPs with matrix. This study explored the strengthening potential and mechanism of GNPs in metal matrix composites with insight of scale-up fabrication.

Key words: Graphene nanoplatelets; Magnesium matrix composites; Mechanical properties; Strengthening efficiency; Strengthening mechanism

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