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Aluminum and Magnesium Metal Matrix Nanocomposites

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Preface

Lightweight materials are getting critically important for weight-saving engineering and biomedical sectors. The use of these materials is getting increasingly important for sustainable planet earth and human comfort. Aluminum and magnesium are two lightweight materials that are of paramount importance for engineers and material selectors. Efforts have been made in past few decades to evolve these two principal elements so that they can cater to a wider spectrum of applications. Composite technology utilizing micron length scale reinforcement was used actively in the past century to realize properties beyond the common alloying technique to enhance certain properties such as elastic modulus, strength, wear and damping response. With the advent of nanotechnology in the late 1990s, researchers worldwide started to use reinforcements at nano-length scale (<100 nm). The resultant nanocomposites exhibited superior combination of properties when compared to micro-composites with significantly reduced weight penalty. In view of significantly different response of elemental matrix in the presence of reinforcement at nano-length scale, it was realized by authors to put together current level of understanding of aluminum and magnesium based nanocomposites. It is hoped that this book will serve as a useful reference for students, teachers, engineers, and researchers to gain understanding of these fascinating materials.

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Contents

Abbreviations

ADZ	Alumina Depleted Zones
ARB	Accumulative Roll Bonding
BM	Ball Milling
BPR	Ball-to-Powder Ratio
CARB	Cross Accumulative Roll Bonding
CMA	Complex Metallic Alloys
CNF	Carbon Nanofiber
CNT	Carbon Nanotube
CP	Cold Pressing
CRP	Continuous Rheo-conversion Process
CRSS	Critical Resolved Shear Stress
CTE	Coefficient of Thermal Expansion
CYS	Compressive Yield Strength
DMD	Disintegrated Melt Deposition
DRA	Discontinuously Reinforced Aluminium composite
EBSD	Electron Backscatter Diffraction
ECAP	Equal Channel Angular Pressing
EDS	Energy Dispersive X-ray Spectroscopy
EM	Elastic Modulus
EPMA	Electron Probe Microscopic Analysis
FESEM	Field Emission Scanning Electron Microscopy
FSP	Friction Stir Processing
GISS	Gas Induced Semi-Solid process
GNP	Graphene Nanoplatelet
HB	Brinell Hardness
HCF	High Cycle Fatigue
HE	Hot Extrusion
HIP	Hot Isostatic Pressing
H-NCM	Hong-Nano Casting Method
HPDC	High Pressure Die Casting

HRTEM	High Resolution Transmission Electron Microscopy
HV	Vickers Hardness
MA	Mechanical Alloying
MMCs	Metal Matrix Composites
MML	Mechanically Mixed Layer
MMNCs	Magnesium Matrix Nanocomposites
MPF	Master Powder Feeding
MW(C)NT	Multi-Walled Carbon Nanotube
NC-US	Non Contact Ultrasonic treatment
ND	Normal Direction
NDZ	Nano-alumina Dispersed Zones
NPs	NanoParticulates or Nanoparticles
NRC	New Rheo Casting process
PCA	Process Control Agent
PM	Powder Metallurgy
RDC	Rheo Die Casting process
RM	Reaction Milling
RSF	Rapid Slurry Forming
SADP	Selected Area Diffraction Pattern
SAED	Selected Area Electron Diffraction
SDAS	Secondary Dendrite Arm Spacing
SEM	Scanning Electron Microscopy
SL	Semisolid–Liquid
SLC	Sub-Liquidus Casting
SLM	Selective Laser Melting
SPS	Spark Plasma Sintering
SS	Semisolid–Semisolid
SSM	Semi-Solid Metal
SSR	Semi-Solid Rheo casting
TEM	Transmission Electron Microscopy
TSRM	Twin Screw Rheo Moulding
TYS	Tensile Yield Strength
UCS	Ultimate Compressive Strength
UFG	Ultra-Fine Grained
US	Ultrasonic treatment
UTS	Ultimate Tensile Strength
vol.%	Volume fraction
wt.%	Weight fraction
XRD	X-Ray Diffraction
YS	Yield Strength