

Contents

1	State of the Art of Metal Matrix Nanocomposites	1
1.1	Metal Matrix Nanocomposites	1
1.1.1	Type of Metal Matrices and Reinforcements	2
1.1.2	Strengthening Mechanisms	3
1.1.3	Preparation Methods and Properties	9
1.2	Processing of Metal Powders	15
1.2.1	High-Energy Ball-Milling	16
1.2.2	Equal Channel Angular Pressing	20
1.2.3	Hot Extrusion	25
1.3	Possible Applications of MMnCs	27
	References	28
2	Experimental Methods	37
2.1	Materials	37
2.1.1	Al Powders	37
2.1.2	Al ₂ O ₃ Nanoparticles	38
2.2	Processing	38
2.2.1	High-Energy Ball Milling	38
2.2.2	Equal Channel Angular Pressing (ECAP)	39
2.2.3	Hot Extrusion	39
2.2.4	Rolling	40
2.3	Characterization Techniques	40
2.3.1	Scanning Electron Microscope (SEM)	40
2.3.2	Transmission Electron Microscopy (TEM)	40
2.3.3	X-Ray Diffraction (XRD)	41
2.3.4	Tensile and Compression Testing	41
2.3.5	Vickers Hardness	42
2.3.6	Density Testing	42
2.3.7	Instrumented Indentation	42

2.3.8	Dynamic-Mechanical Analysis (DMA)	44
2.3.9	Thermal Analysis	44
	References	45
3	Consolidations of Al Powder and Dry Al₂O₃ Nanoparticles	47
3.1	Powder Characterization	47
3.2	Powder Consolidation	50
3.3	Mechanical Characterization	52
3.4	Microstructural Characterization.	53
	References	58
4	Consolidation of Al Powder and Colloidal Suspension of Al₂O₃ Nanoparticles after 2 h Ball Milling	59
4.1	Powder Characterization	59
4.2	Powder Consolidation	60
4.3	Mechanical Characterization	61
4.4	Microstructural Characterization.	61
	References	64
5	Consolidation of Al Powder and Colloidal Suspension of Al₂O₃ Nanoparticles After 16 h Ball Milling	65
5.1	Powder Characterization	65
5.2	Powder Consolidation	68
5.3	Mechanical Characterization of Samples Consolidated by ECAP	69
5.4	Microstructural Characterization of the Samples Consolidated by ECAP	71
5.5	Mechanical and Functional Characterization of Samples Consolidated by Hot Extrusion and Cold Rolled	74
5.6	Microstructural Characterization of Samples Consolidated by Hot Extrusion and Cold Rolled.	81
5.7	Discussion of the Results	85
5.8	Prediction of Experimental Results.	92
	References	94
6	Consolidation of AL Powder and Colloidal Suspension of Al₂O₃ Nanoparticles After 24 h Ball Milling	97
6.1	Powder Characterization	97
6.2	Powder Consolidation	98
6.3	Mechanical Characterization	100
6.4	Microstructural Characterization.	102
	Reference.	105

7	Consolidation of Micro- and Nano-Sized Al Powder	107
7.1	Powder Characterization	108
7.2	Powder Consolidation	109
7.3	Mechanical Characterization	111
7.4	Microstructural Characterization	112
7.5	Discussion of the Results	116
	References	121
8	Conclusions	125

Aluminum Matrix Composites Reinforced with Alumina
Nanoparticles

Casati, R.

2016, XII, 126 p. 85 illus. in color., Softcover

ISBN: 978-3-319-27731-8