

Contents

1	Cutting Mechanism in Machining Single Crystal Materials	1
1.1	Brittle-Ductile Transition	1
1.1.1	Brittle-Ductile Transition in SPDT	2
1.1.2	Mechanical Representation	4
1.1.3	Critical Cutting Depth	7
1.1.4	Modelling of Critical Cutting Depth	10
1.1.5	Cutting Force and Chips Characterization	14
1.2	Monocular Dynamic Simulation	17
1.2.1	Atomic Arrangement in Nanocutting	17
1.2.2	Lattice Variation in Nanocutting	25
1.2.3	Visualization of Brittle-Ductile Transition	32
	References	36
2	Surface Generation in Machining Single Crystal Materials	39
2.1	Nano-surface Generation	39
2.1.1	Nano-surface Characteristics in SPDT	40
2.1.2	Nano-surface Generation Mechanism	48
2.2	Surface Morphology Controlling	53
2.2.1	Cutting Depth Controlling	54
2.2.2	Cutting Edge Controlling	62
	References	65
3	Cutting Process in Machining Polycrystalline Materials	67
3.1	Property of Irregular Microstructures	67
3.1.1	Irregular Microstructures Generation	68
3.1.2	Cutting Force Characterization of IMS	71
3.1.3	Chip Morphology Characterization of IMS	74
3.2	Surface Generation Mechanism	78
3.2.1	MD Modeling of Nano-cutting	79
3.2.2	Visualization of Surface Generation Mechanism	82
	References	87

4	Cutting Process in Machining Amorphous Materials	89
4.1	Machining Performance of Amorphous Materials	89
4.1.1	Advanced Application of AM	89
4.1.2	SPDT of Amorphous Materials	92
4.1.3	Machining Performance and Analysis	93
4.1.4	Non-traditional Machining Methods for Amorphous Alloys	99
4.2	Surface Generation Mechanism	100
4.2.1	Modelling	100
4.2.2	Visualization of Surface Generation	104
	References	106
5	Tool Wear Mechanism and Suppression in Machining Ferrous Materials	109
5.1	Electrochemical Tool Wear Mechanism	109
5.1.1	Electrochemical Tool Wear Rate	109
5.1.2	Graphitization Wear	111
5.1.3	Oxidative Wear	112
5.2	Tool Wear Suppression Methods	115
5.2.1	Effect of Tools, Workpieces and Cutting Parameters	115
5.2.2	Effect of External Energy Field Assisted	120
	References	138
6	Cutting Process in Machining Ferrous Materials	147
6.1	Intermittent Cutting Technology	147
6.2	Lubricant Effects	150
6.2.1	Machined Surface	151
6.2.2	Tool Marks	161
	References	171
7	Size Effect on Cutting Process in Precision Machining	173
7.1	Size Effect of Cutting Edge	173
7.1.1	Micro-milling Experiments	175
7.1.2	Size Effect in Micro-milling	179
7.2	Size Effect of Cutting Depth	188
7.2.1	Ultra-precision Fly Cutting Experiments	188
7.2.2	Size Effect in Ultra-precision Fly Cutting	189
7.2.3	FE Simulation	193
7.2.4	SRP Formation and Suppression	199
	References	206
8	Synthetic Diamond and Application in Precision Machining	209
8.1	Diamond Synthesis Process	209
8.1.1	Classification of Diamonds	209
8.1.2	Diamond Synthesis Method	211

- 8.1.3 Diamond Synthesis Experiments 212
 - 8.1.4 Synthetic Diamond Properties 214
- 8.2 Diamond Tool Preparation and Cutting Performance 221
 - 8.2.1 Diamond Tools Preparation 221
 - 8.2.2 Cutting Performance in UPM 222
- References 230