

# Contents

<b>1</b>	<b>General Introduction</b>	<b>1</b>
1.1	Laser Shock Wave and Laser Shock Processing	1
1.2	Recent Development of Laser Shock Processing	4
1.3	Practical Applications of LSP	6
1.4	Scope of This Book	7
	References	8
<b>2</b>	<b>LSP Numerical Simulation</b>	<b>11</b>
2.1	Introduction	11
2.2	A Finite Element Analysis of Thermal Relaxation of Residual Stress in Laser Shock Processing Ni-based Alloy GH4169	12
2.2.1	Introduction	12
2.2.2	LSP Simulation	13
2.2.3	Results and Discussion	16
2.2.4	Summary	18
2.3	Comparison of the Simulation and Experimental Fatigue Crack Behaviors in the Nanoseconds Laser Shocked Aluminum Alloy	19
2.3.1	Introduction	19
2.3.2	Simulation Methods	20
2.3.3	Experimental Methods	22
2.3.4	Results and Discussions	23
2.3.5	Summary	29
	References	29

<b>3</b>	<b>Laser Shock Processing at Elevated Temperature</b>	<b>33</b>
3.1	Introduction	33
3.2	Mechanical Properties and Residual Stresses Changing on 00Cr12 Alloy by Nanoseconds Laser Shock Processing at High Temperatures	34
3.2.1	Introduction	34
3.2.2	LSP on Fatigue Properties at Room Temperature	35
3.2.3	LSP on Fatigue Properties at Elevated Temperature	37
3.2.4	LSP on Residual Stresses at Elevated Temperature	41
3.2.5	Conclusions	46
3.3	High-Temperature Mechanical Properties and Surface Fatigue Behavior Improving of Steel Alloy Via Laser Shock Peening	46
3.3.1	Introduction	47
3.3.2	Experiments and Analysis	48
3.3.3	Results and Discussions	49
3.3.4	Conclusions	53
3.4	Metallographic Structure Evolution and Dislocation Polymorphism Transformation of 6061-T651 Aluminum Alloy Processed by Laser Shock Peening: Effect of Tempering at the Elevated Temperatures	54
3.4.1	Introduction	55
3.4.2	Experimental Procedures	56
3.4.3	Results and Discussions	58
3.4.4	Conclusions	74
	References	74
<b>4</b>	<b>Influence of LSP on Stress Intensity Factor of Hole-Edge Crack</b>	<b>79</b>
4.1	Introduction	79
4.2	Stress Intensity Factor Changing on the Hole Crack Subject to Laser Shock Processing and Influence of Compressive Stress	80
4.2.1	Introduction	80
4.2.2	SIF Formula	82
4.2.3	Experimental Procedures	86
4.2.4	Analysis Model	86
4.2.5	Results and Discussion	96
4.2.6	Conclusions	98

4.3	Investigation of Stress Intensity Factor on 7050-T7451 Aluminum Alloy by High Strain Rate Laser Shock Processing . . . . .	99
4.3.1	Introduction . . . . .	99
4.3.2	Experiments and Method . . . . .	100
4.3.3	Results and Discussions. . . . .	101
4.3.4	Conclusions . . . . .	108
4.4	A Model for Reliability and Confidence Level in Fatigue Statistical Calculation . . . . .	109
4.4.1	Introduction . . . . .	109
4.4.2	Analysis of Statistics Model . . . . .	110
4.4.3	LSP and Fatigue Experiment . . . . .	112
4.4.4	Revision of Statistics Model. . . . .	113
4.4.5	Conclusions . . . . .	118
	References. . . . .	118
5	<b>Conversion Model of Graphite . . . . .</b>	123
5.1	Introduction . . . . .	123
5.2	A Conversion Model of Graphite to Ultra-nano-crystalline Diamond via Laser Processing at Ambient Temperature and Normal Pressure . . . . .	124
5.2.1	Experiment and Method. . . . .	124
5.2.2	Results . . . . .	125
5.2.3	Discussion . . . . .	127
5.2.4	Conclusions . . . . .	130
	References. . . . .	130