

Contents

Preface	iii
Contributors	xi
1 Physics of Laser-Induced Breakdown: An Update	1
Guy M. Weyl	
1.1 Introduction	1
1.2 Creation of Initial Electrons	3
1.3 Electron Growth in Gases	8
1.4 Laser-Induced Breakdown of Solids and Liquids	36
1.5 Concluding Remarks	58
References	59
2 Modeling of Post-Breakdown Phenomena	69
Robert G. Root	
2.1 Introduction	69
2.2 Creation of a Propagating Plasma	70
2.3 Absorption Characteristics of Heated Gases	72
2.4 Features of Propagating Plasmas	75
2.5 One-Dimensional Laser-Supported Combustion Waves	77
2.6 One-Dimensional Laser-Supported Detonation Wave	88
2.7 One-Dimensional Laser-Supported Radiation Wave	92
2.8 Transition Regions	93
2.9 Radial Expansion	95
2.10 Thermal Coupling	99
2.11 Other Factors	100
2.12 Summary	101
References	101
3 Introduction to Laser Plasma Diagnostics	105
Allan A. Hauer and Hector A. Baldis	
3.1 Introduction	105
3.2 Introduction to Optical Diagnostics	110

3.3	Introduction to X-ray Diagnostics	131
	References	161
4	Laser-Sustained Plasmas	169
	Dennis R. Keefer	
4.1	Introduction	169
4.2	Principles of Operation	172
4.3	Analytical Models	182
4.4	Experimental Studies	189
4.5	Applications of the Laser-Sustained Plasma	196
	References	203
5	Inertially Confined Fusion	207
	Robert L. McCrory and John M. Soures	
5.1	Historical Overview	207
5.2	Laser-Fusion Scaling Laws	211
5.3	Coronal Physics	217
5.4	X-ray Generation by Laser-Produced Plasmas	224
5.5	Laser-Driven Ablation	227
5.6	Hydrodynamic Stability of Ablatively Driven Shells	239
5.7	Irradiation Uniformity Requirements	243
5.8	Implosion Experiments	251
	References	260
6	Laser-Based Semiconductor Fabrication	269
	Joseph R. Wachter	
6.1	Aspects of Semiconductor Fabrication	269
6.2	Applications of Lasers in the Semiconductor Industry	276
6.3	Research Areas	283
6.4	Outlook	290
	References	291
7	Spectrochemical Analysis Using Laser Plasma Excitation	295
	Leon J. Radziemski and David A. Cremers	
7.1	Review	295
7.2	Methods and Properties of Analysis Using Laser Plasmas	296
7.3	Analysis of Gases	302
7.4	Analysis of Bulk Liquids	306
7.5	Analysis of Particles	309
7.6	Analysis of Solids	313
7.7	Advances in Instrumentation	318

Contents	xi
7.8 Prognosis	321
References	323
8 Fundamentals of Analysis of Solids by Laser-Produced Plasmas	327
Yong W. Kim	
8.1 Chapter Organization	327
8.2 Introduction	327
8.3 Phenomenology of Laser Heating of Condensed-Phase Targets	330
8.4 Quantitative Spectroscopy	336
8.5 Intensity Measurements and Elemental Analysis	341
8.6 Summary	344
References	345
9 Laser Vaporization for Sample Introduction in Atomic and Mass Spectroscopy	347
Joseph Sneddon, Peter G. Mitchell, and Nicholas S. Nogar	
9.1 Conventional Solid Sample Introduction for Atomic Spectroscopy	347
9.2 Laser Ablation of Solid Samples	350
9.3 Laser Ablation for Sample Introduction in Atomic Spectroscopy	353
9.4 Relative Merits of Laser Ablation for Sample Introduction in Atomic Spectroscopy	363
9.5 Laser Sources for Mass Spectrometry	365
9.6 Applications of Laser Microprobe	369
9.7 Applications of Laser Desorption and Postionization	372
9.8 Conclusion	376
References	376
10 Current New Applications of Laser Plasmas	385
Allan A. Hauer, David W. Forslund, Colin J. McKinstry, Justin S. Wark, Philip J. Hargis, Jr., Roy A. Hamil, and Joseph M. Kindel	
10.1 Introduction	385
10.2 Applications of Laser-Plasma-Generated X-rays and Particles	386
10.3 Laser-Plasma Acceleration of Particles	413

10.4	Laser-Pulsed Power Switching	424
	References	432
Index		437