

Contents

Contents, Volume 1: Principles	viii
Preface to Volume 2	ix
14 Surface Interactions in Plasma Processing	1
14.1 Industrial Plasma Processing	1
14.2 Plasma Active Species	6
14.3 Heterogeneous Interactions with Surfaces	9
14.4 Secondary Electron Emission	15
14.5 Sputtering	17
14.6 Ion Implantation in Solids	31
References	35
15 Atmospheric Pressure Plasma Sources	37
15.1 Characteristics of Industrial Plasma Sources	38
15.2 Atmospheric Pressure Corona Sources	46
15.3 Atmospheric Dielectric Barrier Discharges (DBDs)	50
15.4 The One Atmosphere Uniform Glow Discharge Plasma (OAUGDP)	55
15.5 Arcjet Plasma Sources	65
15.6 Inductively Coupled Plasma Torches	69
References	72
16 Vacuum Plasma Sources	74
16.1 Intermediate-Pressure Plasma Sources	74
16.2 Low-Pressure Plasma Sources	93
16.3 High-Vacuum Plasma Sources	108
16.4 Summary of Plasma Source Parameters	109
References	110
17 Plasma Reactors for Plasma Processing	113
17.1 Plasma Reactors for Surface Treatment	115
17.2 Plasma Reactors for Ion Implantation	139
17.3 Reactors for Ion-Beam-Induced Sputter Deposition	146

17.4 Plasma/Cathode Sputter Deposition Reactors	157
17.5 Reactors for Plasma Chemical Vapor Deposition	167
17.6 Plasma Etching Reactors	179
References	193
18 Specialized Techniques and Devices for Plasma Processing	196
18.1 Vacuum System Operation	196
18.2 Workpiece Current Collection	200
18.3 Remote Exposure Configurations	205
18.4 Motional Averaging to Achieve Uniformity of Effect	211
18.5 Gas Flow Distribution	219
18.6 Electrohydrodynamic (EHD) Flow Control	225
References	239
19 Parametric Plasma Effects On Plasma Processing	240
19.1 The Role of the Plasma	240
19.2 Kinetic Parameters of Plasma Processing	243
19.3 RF Power Coupling	249
19.4 Sheath Thickness Above Workpiece	255
19.5 RF Sheath Phenomenology	263
19.6 Formation of Active Species	271
19.7 The Effect of Electron Magnetization on Active-Species Concentration	277
References	283
20 Diagnostics for Plasma Processing	284
20.1 Experimental Parameters	284
20.2 Gas-Phase Process Monitoring	286
20.3 Plasma Diagnostics	295
20.4 Measurement of Surface Topography	313
20.5 Measurement of Surface Composition	315
20.6 Surface Energy Related Diagnostics	318
20.7 Measurement of Electrical Properties	325
20.8 <i>In Situ</i> Process Monitoring	328
20.9 Endpoint Detection	332
References	333
21 Plasma Treatment of Surfaces	335
21.1 Objectives of Plasma Surface Treatment	335
21.2 Passive Plasma Cleaning	341
21.3 Active Plasma Cleaning	352
21.4 Plasma Sterilization	360
21.5 Treatment of Thin Films	369
21.6 Treatment of Polymeric or Organic Solids	376
21.7 Treatment of Fabrics and Fibers	383
References	396

22 Surface Modification by Implantation and Diffusion	399
22.1 Ion Implantation Technology	399
22.2 Ion Implantation Dose and Depth Profiles	403
22.3 Ion-Beam Implantation	411
22.4 Plasma Ion Implantation	421
22.5 Low-Energy Plasma Thermal Diffusion Treatment	443
References	448
23 Thin-Film Deposition by Evaporative Condensation and Sputtering	451
23.1 Applications of Thin Films	451
23.2 Thin-Film Characteristics	461
23.3 Deposition by Evaporative Condensation	471
23.4 Ion-Beam Sputter Deposition	477
23.5 Plasma-Assisted Ion-Beam Sputter Deposition	490
23.6 Plasma/Cathode Sputter Deposition	495
23.7 Quality Issues in Sputter Deposition	499
References	500
24 Plasma Chemical Vapor Deposition (PCVD)	502
24.1 Thin-Film Deposition by PCVD	502
24.2 Physical and Chemical Processes in PCVD Glow Discharges	510
24.3 Characteristics of Polymeric Thin Films Formed by PCVD	517
24.4 Glow Discharge Polymerization	528
24.5 Glow Discharge Reactors for PCVD	531
24.6 Summary of Deposition Reactor Plasma Parameters	537
References	538
25 Plasma Etching	540
25.1 Survey of Plasma Etching	540
25.2 Pattern Transfer by Plasma-Related Etching	551
25.3 Control Variables for Plasma Etching	573
25.4 The Chemistry of Plasma Etching	578
25.5 Plasma Etching of Microelectronic Materials	597
25.6 Technical Issues in Plasma Etching	605
References	612
Appendices	614
A Nomenclature	614
B Physical Constants	623
C Units and Conversion Factors	624
D Useful Formulae	626
Index	628