

Index

a

- Anode
 - dielectric deposition 197–200, 203–205
 - electrical conductivity 68
 - grooved 15
 - material 68
 - multi-chamber 102–104
 - placement 3, 4, 6
 - poisoning 7, 15, 197–200, 203–205
 - schematic 68, 201, 203, 205–206

b

- Biased target deposition 278–280
- Breakdown
 - electron source 108
 - gas discharge 71

c

- Cathode-neutralizer
 - alternative current 135–136
 - closed electron drift 128–129
 - cold cathode 134–135
 - discharge current 85–86
 - discharge voltage 38–40, 55, 59–60
 - e-beam electrons for neutralization 140–141
 - electron emission 85–86, 93
 - excessive electron emission 71–83
 - heating power 94, 97
 - hot filament 95–105
 - lifetime 94, 98–101
 - hollow cathode 105–126
 - lifetime 126
 - magnetron electrons for neutralization 139–140
 - microwave neutralizer 141
 - plasma bridge neutralizer 126–128
 - plasma bridge on magnetron principles 136–139

- reactive gas impact 115–116
 - rf-neutralizer
 - capacitive 131–133
 - inductive 130–131
 - with closed electron drift 128–129
- Charge exchange ions 34–36

d

- Discharge
 - chamber 7
 - current 20, 22–23, 24, 71
 - description 20, 71
 - types, modifications
 - non-selfsustained mode 20, 71
 - self-sustained mode 20, 71
 - concentrated 20, 71
 - distributed 20, 71
 - voltage 20, 22–23, 24, 71–76, 78–81
- Doubly-ionized particles 36–40, 189

e

- End-Hall ion source
 - End-Hall with double chamber anode 18
 - hybrid end-Hall and closed drift 16–17, 162–163
 - traditional 6–7
 - with buffer area 10
 - with anode and reflector connected 11
 - with anode cooled through a dielectric plate 12–13, 159–160
 - with detachable anode module 161–162
 - with hollow insert under anode 10
 - with HF in discharge channel 6
 - with magnetic coil on axis 8
 - with magnets at base 9
 - with soft iron on top of permanent magnet 9
 - with water-cooled anode and magnets 13

- with working gas applied through a top 14
- with working gas applied through anode 14

h

- Hall-current ion sources 1-27
 - optimum operation 67-83
 - oscillations 53-64
- Hollow cathode
 - as ion source 119
 - designs for electric propulsion 110-115
 - designs for industrial ion sources 115-118
 - keeper 123-124
 - lifetime 87, 124
 - modes of operation 121-122
 - producers 126
 - tip 116-117, 125
 - with tantalum emission 115-118
 - with emissive materials 110-115
- Hot Filament
 - emissivity 219
 - lifetime 87, 99
 - material 68-69
 - placement
 - arch shape 97
 - spiral 95
 - straight line 96
 - shielded 102-105
 - power supply
 - AC 96-100
 - DC 96, 98

i

- Instabilities 53-55
- Ion
 - assisted deposition 272-278
 - refraction coefficient as function of ion assist dose 273-277
 - magnetron deposition 280-281
 - magnetron enhanced deposition 283-285
 - beam
 - sputtering 270-272
 - divergence 25
 - monoenergeticity 25
 - current 23, 223-240
 - current dependence on magnetic field 76-80
 - current dependence on electron emission 76
 - current dependence on discharge voltage 23
 - energy 74-75, 223-224
 - energy distribution 225-228, 233-239

- energy distribution as function of angle 81-82
- energy distribution as function of neutralization 89
- impact on substrate heating 209-222
- biased target deposition 278-280
- negative ions 48-50
- source
 - and vacuum chamber 29-50
 - chamber pumping rate impact 40-41
 - charge-exchange 34-36
 - designs 159-164
 - closed electron drift 2-5, 154-159
 - hybrid 162-164
 - modular end-Hall 161
 - end-Hall with indirect anode cooling 160
 - end-Hall with two HFs 162-163
 - dielectric depositions 41-42
 - doubly ionized particles 36-40,
 - with anode layer 4-5, 158
 - for plasma focusing and welding 253
 - hybrid with end-Hall 173-174
 - multi-channel source 176
 - two stage with extended acceleration zone 175-176
 - wedge-like ion beam 174
 - with ion beam along azimuth 173
 - with magnetic layer 1-5, 154-159
 - with reflector of electrons 175
 - single-stage stationary source 176-177
 - two-lens quasi-stationary source 176-177
 - for science and technology 255-266
 - aerodynamic effects 266
 - hydrogen motion through metal membrane by plasma source 261-262
 - levitation of melts 260-261
 - plasma commutator 256-258
 - plasma optical mass separator 262-263
 - plasma stealth effect 263-266
 - vacuum pump 255-256
 - vacuum valve 258-260
 - stealth effect 263-266
 - heating impact on operation 47
 - linear designs 178, 179-183
 - mass entrainment 32-33
 - need for standardization 190-193
 - negative ions 48-49
 - non-traditional designs 168-178
 - Hall-current-magnetron type 172-173
 - with peripheral magnetic field 169, 171
 - with "cold" cathode 172
 - operating parameters problems 183-190

- operation with reactive gases 197–208
- producers 149–154, 159–168
 - Chinese designs 164–167
 - S. Korean designs 168–170
- rf-sources 177–178
- returned sputtered particle 43–47
- standardization 190–194
- types 3–4, 6, 8–18
- volt-ampere characteristics 19
- volt-mass flow characteristics 22, 80

k

Knudsen parameter 30

m

Maintenance

- anode 199–202
- electron source 115–116
- emissive elements 114, 116
- keeper 116–117, 123, 142
- gas distributor-reflector 188
- permanent magnets 47

Magnetic field,

- influence on ion current 76–77
- in Hall-current ion source 2, 4
- in end-Hall ion source 7–8
- magnet assembly 9
- magnetic field lines 7, 154–155
- magnetic coil 6, 8
- magnetic pole 7
- magnetization of electrons 2
- negative gradient 61
- permanent magnet 6, 9, 10–12
 - heating impact 47, 217
- positive gradient 155
- soft iron 7, 9, 13

Magnetron

- deposition with ion assist 281–282
- magnetron sputtering enhancement
 - with ion assist 283–285
- with equipotential cathode 287–292
- magnetron electrons for ion beam
 - neutralization 139–140, 280–282
- with non-equipotential cathode 292–306

n

Neutralization

- charge of ion beam 85–93, 184
- electric field 92
- charge of ion beam 85–93, 184
- magnetron electrons for ion beam
 - neutralization 139–140, 280–282
- excessive emission 71–83
- over-neutralization 71–76

- sparks 86
- substrate-target 91, 139
- under-neutralization 61–62, 89–90

o

Operation of sources,

- electron sources 85–144
- ion sources 1–26, 159–178
 - efficiency 183
 - coefficient of beam divergence 25
 - coefficient of discharge voltage into energy transformation 24
 - coefficient of discharge current
 - transformation into ion beam current 25
 - coefficient of working gas utilization 25
 - coefficient determining a number of doubly ionized particles 25
 - coefficient determining a number of particles returning back into reflector 26
- operation with excessive electron emission 71
- operation with reactive gases 15, 41–42, 197–208
- operating parameters 20, 24, 71
- problems 183–190
- range of discharge currents 24–25
- range of discharge voltages 24
- standardization 190–193

Oscillations 53–64

- operation with oscillations 184
- types
 - contour oscillations 58–60,
 - due to high pressure in vacuum chamber 61
 - due to incorrect operation 62
 - due to ion beam underneutralization 61–62
 - due to presence of water vapors 62–63
 - ionization oscillations 55–57
 - flight oscillations 58
 - hybrid oscillations 60

p

Plasma optical system

- electrostatic fields in plasma 243–244
- equipotential magnetic field lines 244–245
- plasma lens with space charge 242
- plasma focusing and defocusing 248–254
- plasma lenses 245–248
- plasma optics evolution 242–243
- practical applications
 - for focusing, defocusing 248–249
 - for soldering 249–254
 - for various technological tasks 251

Probe

- ion beam current 72–73, 228–240
- ion beam energy 73–76, 225–228
- retarding potential energy analysis 74–75, 228–240
- with one grid repelling electrons 230
- with shielding and repelling electrons grid 231
- with shielding, repelling, analyzing and suppressor grids 232–233

r

- Radiation impact on substrate heating 209–222
- Reactive gases 197–208
- Reflector-gas-distributor 187–188
- Retarding potential probes 228–240
 - measuring ion beam current 229–230
 - with repelling electrons grid 230–231
 - with shielding and repelling electrons grids 231–232
 - with shielding, repelling, analyzing and suppressor grids 232–233
 - retarding potential curves for gridded ion source 227, 234
 - retarding potential curves for anode layer ion source 235
 - retarding potential curves for end-Hall ion source 74–76, 236–239
 - retarding potential curves for end-Hall ion source

- with quasi-monochromatic ion energy distribution 228, 237
- three-grid design commercial 239–240

s

- Substrate heating by ion source 218–220

v

- Vacuum chamber
 - interaction with ion source 29–50
 - return of sputtered particles 43–47
 - selection 45–47
 - heating 221–222
- Volt-Ampere Characteristics
 - ion source 20, 23, 71, 76–77
 - magnetron with equipotential cathode 293, 294, 298–300
 - magnetron with non-equipotential cathode 294, 298–300
 - volt-working gas mass flow characteristics 22

w

- Water
 - indirect water-cooled anode 12
 - water-cooled anode 13
 - water-cooled magnets 13
 - water vapors impact on oscillations 6, 62