

Index

A

Absorption, 337, 569
 Activation energy of NTD Si:H, 563
 Advanced lithographic technology (E-beam, X-ray, Ion beam, Direct write systems, Photo-resists, Equipment), 662
 Ageing of wires, 468
 Air filtration systems, 163
 Amorphous layers, 661
 Anisotropic etching, 29
 Annealing, 77, 97, 105, 106, 204, 403, 460, 491, 560, 570, 590
 Antimony diffusion, 34
 Apodization function, 345
 Arsenic implantation, 65, 71
 Arsenic diffusion, 26, 34
 Artifact formation, 318
 Artifact transport, 179
 ASTM
 Committee F-1 on Electronics, 3, 10, 11, 12
 F121-80, 50
 Subcommittee F1.07, 4
 Subcommittee F1.10, 173
 Atomic level mechanisms, 32
 Autodoping, 38, 44
 Automation, 14
 Axial dopant distributions, 365
 Axial penning source, 78

B

Backside damage, 257, 324
 Backside scattering, 338
 Ball bonding, 429, 435
 Shearing, 430
 Testing of, 429
 Ball shear, 440, 448
 Ballistic transport, 35
 Bandgap, 33
 Base implant, 66
 Base sheet resistance, 69
 Base width, 24
 Beam geometry, 353
 Beryllium-doped gold wire, 486
 Beta, 70
 Beveling angle measurements, 285

Bipolar

Epitaxy, 49-52
 ICs, 63
 Structure, 24, 25
 Transistors, 63
 Bonding, 429
 Ball, 429, 435
 Bumped tape, 512
 Horns, 472
 Innerlead, 513
 Interdependence of parameters, 518, 524
 TAB, 500, 512
 Thermal shock, 517
 Thermocompression, 429, 472
 Ultrasonic, 458, 472
 Wire, 434, 458, 485
 Bonding horns, 472
 Bonding machine techniques, 513
 Bonding wire, 434, 458, 485
 Ageing, 468
 Fine wire, 458
 Mech. properties, 461, 488
 Book of Standards, 11
 Boron in silicon, 390, 409
 Channel implants, 22
 Diffusivity, 30, 31
 implant, 30, 401, 409
 Borophosphosilicate glass, 358, 364
 Bragg reflection, 98
 Bulk
 Devices, 78
 Microdefects, 52, 60
 Stacking faults, 231, 235
 Bumped tape bonds, 513
 Buried layers, 40, 77

C

Capacitive bonder tuning, 472
 Capacitive microphone tuning, 473
 Capillary bonding tool, 481
 Carbon in silicon, 325
 Carrier continuity equation, 24
 Carrier lifetime, 658
 Channel length, 27
 Channel effects, 24
 Charge states, 32
 Classical implants, 88

- Clean rooms, 10
 - CMOS epitaxy, 49, 50
 - Co-diffusion, 69
 - Compressional sound waves, 473
 - Computer modeling, 21, 30, 66, 74, 391, 609
 - Container cleaning, 178
 - Contamination, 163, 172, 184, 443
 - Colloidal, 186
 - In bonding, 443
 - Ionic, 167
 - Levels, 173, 186
 - Metal, 241, 257, 272
 - Microbial, 167
 - Particulate, 164, 172, 196
 - Radiant energy, 170
 - Vibration, 170
 - Cooperative research, 647
 - University point-of-view, 648
 - Copper precipitates, 247
 - Crack theory, 278
 - Cross contamination, 266
 - Crystallinity, 102
 - C-V characteristics, 555
 - CVD oxide, 28
 - CVD system, 274
 - Cyclotron, 78
 - Czochralski crystal, 231
- D
- Damage due to implant, 77, 80
 - Damage profiles, 82-85, 88-91
 - Dark conductivity, 559
 - dB pressure level, 477
 - Dechanneling, 72, 75
 - Deep level transient spectroscopy, 543, 568
 - Defects, 243, 247, 283, 309, 566, 657
 - Defect delineation
 - Schimmel etch, 311
 - Seeco etch, 245
 - Sirtl etch, 309
 - Wright etch, 52, 208
 - Yang etch, 309
 - DLTS, 543, 568
 - Denudation, 50
 - Denuded cycle zone, 49, 50, 201, 209, 221, 232
 - Depth profile, 409
 - Detector-grade silicon, 542, 546
 - Detector, non-linearity, 344
 - Device
 - Isolation, 29
 - Modeling, 21, 24
 - Performance, 13
 - Problems, 24
 - Physics, 35
 - Reliability, 9, 12
 - Scaling, 26
 - Dichlorosilane, 38
 - Diffusion, 21, 30-32, 72
 - Antimony, 34
 - Arsenic, 26, 34
 - Base, 72
 - Diffusion
 - Emitter, 72
 - Interstitial, 33
 - Phosphorus, 26
 - Dilute aluminum alloys, 458
 - DIN, 12
 - Diode C-V characteristics, 84
 - Direct write lithographic system, 662
 - Dislocations, 32, 247
 - Doped poly, 26
 - Doping profile, distribution, 65, 81, 409
 - Dose vs generation rate, 87
 - Double crystal x-ray diffraction, 96, 97, 103, 104
 - Kinematical theory, 96-98
 - Drive-in, 65
 - Dry etching, 110
 - Using NF_3/Ar plasma, 110
 - Using NF_3/He plasma, 110
- E
- E-beam system, 127, 662
 - E-center, 77
 - Edge-controlled proximity corrections, 124, 129
 - Electron-beam lithography, 124
 - Electron-pair generation, 90
 - Electron resist, 125
 - Electron spin resonance, 558
 - Electronic characterization, 577, 588
 - Electronics, 9
 - Electronic straggling, 92
 - Electrostatically-scanned ion implanter, 64, 68, 72
 - Emission of particles, 81
 - Emitter dip effect, 223
 - Emitter transistor, 65, 66
 - Energy vs generation rate, 87
 - Enhanced precipitation, 52
 - Environmental control, 10, 11
 - Epitaxy, 11, 38, 49, 274, 325
 - Epitaxial deposition, 274
 - Rates, 41, 43
 - Epitaxial layer thickness, 11, 325
 - Equipotential contours, 26, 28
 - Etch & refill techniques, 28, 29
 - Evaluation of contamination, 172, 184
 - Oxide breakdown, 196
 - Extinction length, 97
 - Extrinsic gettering, 257, 272
- F
- Fine wire, 458
 - Float-zone silicon, 365, 533, 546, 566, 595, 605, 615
 - Four-point probe, 11
 - Focal plane distributions, 151
 - Focal plane statistics, 149
 - Fracture Marking & Tracing, 298
 - FTIR measurements, 204, 231, 320, 325, 335, 345, 358, 567

G

Gain control, 63
Gain in bipolar transistors, 63
66, 68
Gallium arsenide, 575, 587
Gases, 13
Gas phase doping, 39
Gate arrays, 505
Gate oxidation, 27
Generation lifetime, 236
Generation rate vs dose, 87
Energy dependence, 87
Germanium concentration, 272
Gettering efficiency, 279, 659
Gold gettering, 281
Gold profile, 225, 228, 280
Gorey-Schneider probe grinder,
379, 394
Guinier-Preston (GP) zone, 459

H

Hall measurements, 578, 589
Haze, 659
Haze/fog test, 257
Hcl oxidation, 225
Heavy metals, 257, 273
He-Ne laser, 176
Hiconex sputtering source, 78
High energy implanter, 77
High lead count, 507
Horizontal reactors (epi), 44
Hybrid bonding, 434
Testing of, 429
Hydrogenated amorphous NTD
silicon, 558

I

ICs, 9, 13
Implant
Angle, 72
Classical, 88
Dose, 67
In gallium arsenide, 77, 82
In germanium, 77, 85
In glass, 77, 81
In silicon, 77, 85
In quartz, 77
With heavy ions, 78
Implant species, 77
Boron, 30, 401, 409
Carbon, 77, 82
Nitrogen, 77
Noble gases (Ne, Kr,...),
77, 80, 82, 90
Oxygen, 77
Phosphorus, 96, 102, 105
Implanted thyristor, 84, 85
Impurity diffusivity, 34
Impurity profiles
In channel regions, 23
In field regions, 23
Impurity segregation, 69
Indium precipitates, 251
Infrared measurements, 335,
343

Institute of Environmental
Sciences, 15
Interconnects, 458
Interconnection technology, 502
Interferometric patterns, 144
Interlaboratory testing, 11, 15
Interstitials, 31, 288
Interstitial oxygen, 50, 201,
235, 335
Intrinsic getter cycle, 51
Intrinsic implant, 73
Intrinsic or internal gettering,
50, 202, 222, 231, 238, 241,
252
Inversion layer, 22
Ion beam angle, 69
Ion beam lithographic system,
662
Ion channeling, 63, 72, 81, 587
Ion etch system, 112
Ion implantation, 63, 77, 660
Amorphous layers, 661
Tilting, 66
Ion implanters, 66, 68
Ionization profile, 90
IR absorption, 569
Iron precipitates, 247
Irradiation of glass, 88
Isochronal annealing, 570
Isotropic etching, 29
I-V characteristics, 26

J

JEDEC, 10

K

Kinematical theory
Double crystal x-ray
diffraction, 96-98

L

Large devices, 22, 36
Lateral autodoping, 44, 46
Lattice damage, 90
Lattice disorder, 103
Lattice strain (implant), 96,
106, 107
Leakage current, 90
Lifetime, 11, 49, 55, 554, 571,
658
Generation, 236
In epitaxial layers, 60
Minority carrier, 49, 51,
55, 59, 92, 236
Light scattering devices, 176
Lithographic equipment, 662
Lithographic patterns, 125,
130-134
Lithography, 124, 662
Liquid cleanliness, 174
Local diffusivities, 35
Local slope, 150, 151
LOCOS isolation structures, 28
Low temperature donors, 201
LPCVD, 29

M

Magnetic Czochralski, 231
 Manufacturing efficiency, 9
 Matte finish, 483
 MCNC, 648
 Mechanical properties of wires, 461, 488
 Mechanical strength, silicon, 659
 Mechanically-scanned ion implanter, 64, 66
 Metal contamination, 241, 257, 272
 Metal precipitation, 241, 247
 Methylisobutyl ketone, 134
 Microdefect formation, 210
 Microdefects, 52, 60
 Microelectronic interconnects, 458
 Microphone probe, 475
 Microporous membrane, 188
 Microsampling, 325
 Mil specs, 12
 Military standards, 9, 10
 Minority carrier lifetime, 49, 51, 55, 59, 92, 554
 Of generation, 92
 Of recombination, 92
 Misfit dislocations, 272
 Modeling, 609
 Molecular diffusion, 32
 Monte-Carlo calculations, 77, 91, 125
 Monocrystalline implantation, 82
 MOS c-t measurements, 55, 58, 59
 MOS device operation, 24

N

NASA, 13
 National Bureau of Standards, 11
 Neutron activation analysis, 257
 Neutron depth profiling (NDP), 412, 661
 Neutron flux, 601, 608, 618
 Neutron flux equilization, 612
 Neutron irradiation, 533, 546, 559, 566, 575, 587, 595, 605, 615, 628
 Neutron transmutation doping (NTD), 533, 546, 558, 566, 575, 587, 595, 605, 615, 628
 NF₃, 111
 NF₃/Ar plasma, 110
 NF₃/He plasma, 110, 114
 Nickel precipitates, 249
 Nitrogen trifluoride, 111
 NMOS
 Device, 27
 Process, 23, 26
 N/N+ epi-layers, 51
 Nomarski microscope, 275
 Non-uniformities in implants, 68

N/P epi-layers, 52
 NTD
 gallium arsenide, 575, 587
 Annealing behavior, 590
 Electronic characterization, 577, 588
 Hall measurements, 578, 589
 Photoluminescence, 578, 583, 591
 NTD reactor, 533, 559, 575, 587, 595, 605, 615, 628
 NTD silicon, 533, 546, 558, 566, 595, 605, 615, 628
 Annealing behavior, 560, 570
 Computer modeling, 609
 Crystal quality, 538
 C-V characteristics, 555
 Dark conductivity, 559
 Defects, 566
 Detector-grade, 542, 546
 Effects of hydrogen, 558, 566
 Electron spin resonance, 558
 Lifetime, 554, 571
 Market development, 534
 Maximum diameter, 539, 546, 615, 628
 Nuclear parameters, 595
 Overcompensation, 553
 Photoconductivity, 559
 Radial resistivity variation, 550, 571, 605
 Total capacity, 595
 Upper resistivity limit, 540
 Nuclear reaction, 81
 Nucleation, 50, 220

O

OED, 30
 Off-line computer simulations, 143, 146
 Optical absorption, 77, 81, 88
 Optical analyzer, 88
 Optical reflectivity, 77, 89, 90
 OSFs, 223
 Outdiffusion, 40, 220
 Outgassing, 168
 Polymeric materials, 168
 Oxidation, 21, 30
 Oxidation-enhanced diffusion, 30, 106, 283, 286
 Oxidation-induced stacking faults, 223, 316
 Oxidation measurements, 320, 325, 343
 Effects of backside damage, 324
 Polarization effects, 353
 Oxidation rate, 27
 Oxide-isolated structure, 24
 Oxygen diffusivity, 221, 223
 Oxygen precipitation, 49, 50, 201, 211, 220, 232, 658

P

Packaging, 507

- Panel & workshop discussions,
 - 647, 654, 657
 - Advanced lithographic technology, 662
 - Control of contaminants, 654
 - Cooperative research, 647
 - Interconnection technology, 655
 - Ion implant, 660
 - Material and process-induced defects, 657
 - Participation in standards work, 14,15
 - Particles, 163
 - Airbourne, 163
 - Effect of electrostatic charge, 169
 - Measurements of, 172
 - Microbial, 167
 - Migrating, 164, 165
 - Surface, 165
 - Viable, 167, 179
 - Particulate contamination, 9, 11, 14
 - Particle profiles, 77
 - Passivation, 566
 - Phosphorus diffusion, 26
 - Phosphorus implant, 96, 102, 105
 - Phosphorus in silicon, 358, 364
 - Photoconductive decay, 11
 - Photoconductive measurements, 560
 - Photoconductivity, 559
 - Photolithographic process
 - Off line computer simulations, 143, 146
 - Photoluminescence, 578, 583, 591
 - Photoresist
 - Etching, 120, 121
 - Electron, 125
 - PMMA, 125
 - Positive, 120
 - Technology, 662
 - PISCES program, 35
 - Planar channeling, 69
 - Plasma etching, 110
 - PMMA photoresist, 125
 - P-N junction, 84
 - POCl₃ doping, 22
 - Point contact diode, 378
 - Point defects, 37, 219, 283
 - Interaction, 58
 - Nucleation, 220
 - Outdiffusion, 220
 - Point-of-use filtration, 184, 191
 - Polarization effects, 353
 - Poly gate, 22
 - Polysilicon, 364
 - Deposition, 24
 - Arsenic-doped, 24
 - Etching, 111, 113
 - Oxidation, 27
 - Polymeric materials, 168
 - P/P+ epi-layers, 52
 - Positive photoresist, 120
 - Precipitate-defect clustures, 230
 - Precipitates
 - Copper, 251
 - Indium, 251
 - Iron, 247
 - Metal, 241, 251
 - Nickel, 249
 - Oxygen, 201, 211, 220, 232
 - Precipitation density profile, 228
 - Pre-epitaxial bake, 39
 - Preferential etch, 309, 311
 - Process chemicals, 13
 - Process-induced defects, 232
 - Process modeling, 21, 30, 34
 - Process perturbation, 27
 - Production equipment, 14
 - Programs
 - Bell Laboratories, 35
 - Fielday, 35
 - PISCES, 35
 - SUPREM, 21, 30
 - Proximity effect, 124
 - Pull test, 429, 462
 - Pull strength, 527
 - Purity, 13
- Q
- Quality
 - NTD silicon, 538
- R
- RADC, 13
 - Reactive ion etching, 110, 117
 - Reactor
 - Advanced Test, 615, 628
 - Design, 595, 605, 628
 - Epitaxial, 21, 24, 36
 - Heavy water, 605
 - Horizontal hole, 595
 - NTD, 533, 546, 559, 575, 587, 595
 - Recombination velocity, 283
 - Reliability, 9, 12
 - Resists
 - Electron, 125
 - PMMA, 125
 - Positive, 120
 - Resistivity measurements, 11
 - Retarded diffusion, 34
 - Reverse recovery charge, 93
 - Roles of Microelectronics Centers, 649
 - Round robin testing, 11
- S
- Scaling, 26
 - Seeco etch, 245
 - Selective etching, 110
 - Selectivity, 112, 114, 121
 - SEMI, 10-13
 - Semiconductor quality, 9
 - Semiconductor Research Cooperative, 647
 - Semiconductor wire bonds, 429
 - Testing of, 429

- Shadowing effect, 167
- Shallow pits, 257
- Shear test, 430
- Shockley-Hall-Read statistics, 84
- Shuttle tube irradiation, 634
- Silicon/Silicon dioxide, 31
- Silane deposition, 274
- Silicate glasses, 358
- Silicon
 - Breakage, 297
 - Czochralski, 231
 - Dry etching, 110
 - Epitaxial layers, 38, 49
 - On heavily-doped substrates, 50
 - Float zone, 365, 533, 546, 566, 595, 605, 615
 - Magnetic Czochralski, 231
 - Mechanical strength, 659
 - Nitride, 22
 - Oxide, 22, 110
 - Phosphorus-doped, 22
 - Thermal, 22
 - Poly, 364
 - Substrates, 9
 - Silicon-on-sapphire, 401
 - Silicon tetrachloride, 41, 44
 - SIMS, 66, 102, 208, 224, 272, 278, 390, 411, 661
 - Simulation, 21, 24, 28, 36, 66, 69, 74
 - Simulated spectra, 336
 - Single crystal growth, 26
 - Silicon oxide/nitride, 30
 - Silicon oxide precipitation, 50
 - Small VLSI devices, 24, 28, 30, 35, 36
 - Channel effects, 24
 - Electric fields in, 24
 - Source-drain implants, 22
 - Spatial manipulation, 148
 - Specifications, 9
 - Spreading resistance measurements, 375, 390, 411
 - Effect of probe penetration, 382
 - Effect of rf radiation, 383
 - Spreading resistance technique-applications, 46, 77, 80, 84, 205, 551, 661
 - Stacking faults
 - Bulk, 231, 235
 - Oxygen-induced, 223, 316
 - Standard Reference Materials (SRM) program, 3, 10
 - Standards, 9-13
 - Communications, 13
 - Development, 9
 - Types, 10
 - Stanford University, 28
 - Stepper simulations, 155
 - Strain, 32
 - Distributions, 97, 99, 100, 101, 105
 - Sublimation effects, 83
 - Submicrometre contaminants, 172, 180
 - Substrates, 9
 - Sub-threshold
 - currents, 26
 - region, 24
 - Super beta, 72
 - SUPREM, 21-23, 66, 69, 74, 391
 - Surface
 - contamination, 11
 - current, 86
 - films, 168
 - oxidation, 31
 - Swirl patterns, 315

T

 - Tape Automatic Bonding [TAB], 500, 512
 - TEM, 242, 274, 279
 - Testing equipment, 14
 - Thermal donors, 201
 - Thermal oxidation, 28, 29, 32
 - Thermosonic bonding, 429, 472
 - Temperature effects, 445
 - Threshold voltage, 22, 27
 - Thyristors, 77, 84
 - Transistor structure
 - shallow emitter, 72
 - Traps, 32
 - Trench-like structures, 28
 - Leakage currents in, 30
 - Trichlorosilane, 51
 - Two dimensional
 - kinetics, 34
 - process simulation, 35
 - structures, 35

U

 - Ultrafiltration, 187, 190
 - Ultrasonic bonding tool, 458, 472, 483
 - Ultrasonic power node, 472
 - University research, 648, 650
 - Upward diffusion, 24

V

 - Vacancies, 31, 32, 88, 290
 - Energy level, 33
 - Formation, 58
 - Impurity, 33
 - Van de Graaff cyclotron, 78
 - Vertical pancake reactor, 38
 - Vibrations, 170
 - VICKSI accelerator, 78, 93
 - VLSI/VHSIC structures, 21, 501, 506
 - Volumetric sensor system, 177

W

 - Wafer
 - flatness, 143
 - fracture, 297
 - warpage, 236
 - Water, 184
 - Wet oxidation, 234
 - White room, 9

Wire bond deformation, 479
 Wire bonding, 434
 Testing of, 429
 Failure modes, 451
 Workshop discussions, 654
 Control of contaminants, 654
 Interconnection Technology,
 655
 Wright etch, 52, 208

X

XPS, 111, 116
 X-ray
 -lithographic system, 662

X-ray photoelectron spectroscopy
 111, 116, 121
 -rocking curves, 96, 97, 99
 100, 104
 -spectrometer, 242

Y

Yield enhancement, 144, 152

Z

Zero-dislocation crystals, 370
 Zone refining, 365, 370
 Zone length, 365, 368