

- silicon (*continued*)
- history 157–61
  - impurities 155
  - mechanical properties 155
  - miscellaneous applications 161
  - multicrystalline wafers 176
  - occurrence 154
  - oxygen as impurity in 187–8
  - physical properties relevant for
    - photovoltaics 154–5
  - precipitates in 190–3
  - refractive index 155
  - requirements for crystalline solar cells
    - 179
  - semiconductor material 160–1
  - single-crystal wafers 154, 176
  - solar grade feedstock 153–204
  - solidification 179–82
  - thermal properties 155
  - transition-metal impurities in 188–90
  - ultra-pure 160–1
  - see also* metallurgical grade silicon;
    - semiconductor grade silicon; solar grade silicon routes
- silicon alloys 157
- band gaps 544–6
  - doping 528
- silicon applications 157–61
- in aluminum industry 158–9
  - in chemistry 159–60
- Silicon Film (SF) 230, 239–42, 244, 251
- silicon metal 157–8, 161
- silicon monoxide 163
- silicon multicrystalline sawn wafers 154
- silicon nitride 243, 283
- passivation 281
- silicon ribbon crystal growth technology,
  - productivity comparisons 238–9
- silicon ribbon/foil growth techniques 232
- silicon ribbon/foil production 230–44
- manufacturing technology 239–40
  - process description 232–8
- silicon ribbon/foil technology 231
- future directions 243–4
- silicon ribbon material properties and solar cells 240–3
- silicon ribbon/multicrystalline film 176
- silicon ribbon wafer/foil technologies 251
- silicon ribbons 288
- silicon solar cells 240–3
- power density 421
  - space applications 425–6
  - temperature coefficients 719
- silicon tetrachloride 159, 171
- silicon-wafer-based PV module costs 25
- silicones 159
- SIMS (secondary ion mass spectroscopy) 347
- simulation of bulk silicon crystallization 247–9
- simulation of silicon ribbon growth 249–51
- simulation tools 245
- single level trap (SLT) 75
- single-crystal silicon 207
- single-crystalline solar cells 256
- single-junction solar cells 37, 74
- physics of 363–5
- sizing
  - stand-alone systems 953–6
  - system 791–3
- sky irradiance, angular distribution of 929
- Skylab 1 414
- SLI (starting, lighting, ignition) batteries 809, 834
- small area champion cells 20
- smart cut method 317
- Sofrel flat-roof system 1018
- soft loans 1095–6
- solar altitude 909
- solar arrays, space applications 431–41
- solar azimuth 909
- solar batteries 1052
- solar cell 3, 5
- spectral response of 100–2
- solar cells
  - back-contact 108
  - band diagram of 120
  - basic structure 87
  - boundary conditions 87–9
  - circuit model 92, 102
  - color 1035
  - cost 26
  - current-voltage characteristic of 103
  - design 62
  - efficiency 99–100, 362
  - efficiency levels 242
  - efficiency versus impurity concentration 192
  - efficiency versus thickness 242
  - equilibrium conditions 86
  - fabrication 26
  - fundamentals 87–99
  - future-generation 403–6
  - higher-than-one quantum efficiency 140–1
  - intermediate band 144–8
  - lifetime 96–7
  - manufacturing 26
  - materials, BIPV 1030–4
  - model parameters 94
  - numerical modeling of 109–10
  - operation 63, 84, 98–9