Index

ablation
  concepts and definitions, 26
  intradermal vaccination, 77, 83–4
  laser microporation, 170
  radiofrequency microporation, 173
  thermal microporation, 172–3

absorption
  applied concentration/dose, 15
  chemical modulation of permeation, 20–26
  ethnicity, 19
  ionisation, 15–16
  molecular size and shape, 14–15
  partition coefficient, 13–14
  physical modulation of permeation, 26–30
  physicochemical properties of penetrant, 13, 20–30
  physiological properties of the skin, 16–19
  regional variation, 18
  routes of absorption, 9
  skin age, 17–18
  skin condition, 16–17
  skin hydration and occlusion, 17
  skin temperature, 19
  solubility and melting point, 15
  theoretical considerations, 11–16
  transdermal permeation, 9–11
  vehicle effects, 19–20

acetanilide, 108–9
acne scars, 193
active cosmeceuticals see cosmeceuticals
acylceramides, 9
adjuvants, 73
adrenaline, 169
AE see atopic eczema
aerosols, 98–9, 104, 106
aesthetics, 247
ageing
  absorption, 17–18
  cosmeceuticals, 215, 218, 221–3, 225–30
  microneedles, 191
  Alzheimer’s disease, 188, 190
  amyloid-beta peptides, 188
  amyloplasts, 150–151
  anaesthesia, 115
  analytical method validation, 253–4
  anionic surfactants, 22–3
  anthrax, 190
  antibodies, 73
  antigen-presenting cells (APC), 188, 196
  anti-nucleant polymers, 102
  antioxidants, 210, 212, 227–8
  APC see antigen-presenting cells
  apocrine sweat glands, 2–3
  aquasomes, 218
ascorbic acid, 193, 210
asymmetric oxygen carrier system
liposomes, 218
atopic eczema (AE), 44
attenuated total reflectance–Fourier transform
IR (ATR FTIR), 43–4
Azone, 21, 23
basal cell carcinoma (BCC), 46
benzoic acid, 151
biocompatibility
cosmeceuticals, 210
microneedles, 183, 185
nanotechnology, 132–3, 136
botanical extracts, 215, 223
bricks-and-mortar model, 7–8, 10–11, 41–2, 110–111, 126
Camellia sinensis, 215
candidate drugs, 246
carbon-based nanomaterials, 130, 137
cationic surfactants, 22–3
CC-chemokine receptor 7 (CCR7), 73–4
CEMOVIS see cryo transmission electron microscopy of vitreous sections
ceramic microneedles, 182
ceramides, 7–9, 57, 59, 67, 215
CHADD see Controlled Heat-Assisted Drug Delivery
chemical penetration enhancers
concepts and definitions, 21–4, 148
electret-mediated drug delivery, 158
film-forming systems, 103–5
heated systems, 113
childhood, 17–18
chitosan, 133–4
cholesterol, 57, 59, 67
C-mechanoreceptors, 4
CNP see cyanophenol
coated microneedles, 180–182, 186, 189–91
colloids, 231
compendial methods for drug release, 251
cryo transmission electron microscopy (CEMOVIS), 57–69
critical processing parameters (CPP), 253
critical quality attribute (CQA), 249–50, 253–4
CSLM see confocal scanning light microscopy
CTL see cytotoxic T lymphocytes
cubosomes, 219
cyanophenol (CNP), 43–4
cyclohextrins, 228–9
cytotoxic T lymphocytes (CTL), 74, 85–7
DAB see droplet-born air blown
D-AMB see desoxycholate amphotericin B
DC see dendritic cells
dcj see disposable cartridge jet injectors
decylmethyl sulphoxide (DEMSO), 49
depreeactive ion etching, 182
degree of saturation (DS), 100–102, 105
demso see decylmethyl sulphoxide
dendrimers, 130–132, 219–20
dendritic cells (DC)
dermal dendritic cell network, 77–9
DTR-DT depletion system, 82–4
human dendritic cells in the skin, 80–81
immunobiology, 73–4
intradermal vaccination, 73–84
Langerhans cells, 73, 76–84
Langerin-DTR mouse models, 83–4
role of skin in vaccine delivery, 75–6
skin anatomy and physiology, 74–5
skin dendritic cell network, 76–82
skin-draining lymph nodes, 73–4, 76–80
T cell differentiation, 84–7
transdermal immunisation, 81–2
dendrosomes, 219–20
depth profiling, 45–6
dermatoglyphs, 127, 137
dermis
anatomy and physiology, 2, 3–4
heated systems, 111–12
intradermal vaccination, 74–5, 77–81
product/device development, 245–53
subcutaneous sensory mechanism, 3–4
desoximetasone, 106
desoxycholate amphotericin B (D-AMB), 133
dextran, 157
diamagnetism, 150
diclofenac, 106–7
differential scanning calorimetry (DSC), 159
diffusion coefficient, heated systems, 107–8
dimethylacetamide (DMAc), 22–3
dimethyl ether, 99
dimethylformamide (DMF), 22–3
dimethylisopropylcarbinol (DMI), 103
dimethylsulphoxide (DMSO), 21–3, 46, 49
diphtheria toxin (DTR-DT) depletion system, 82–4
disposable cartridge jet injectors (DCJI), 164
dissolution testing, 251–2
dissolvable microneedles, 180–182, 184, 188–9, 196
DMAC see dimethylacetamide
DMF see dimethylformamide
DMI see dimethylisopropylcarbinol
DMSO see dimethylsulphoxide
docetaxel, 187
Donnan exclusion effect, 138
dosage and dosage form, 15, 246–7
DPPG see propylene glycol dipelargonate
droplet-born air blown (DAB) method, 184–5
drug candidate selection, 246
drug-release modifiers, 131
dry powder formulations, 164
DS see degree of saturation
DSC see differential scanning calorimetry
DTR-DT see diphtheria toxin
E-cadherin, 76, 81
eccrine sweat glands, 2–3
ECG see electrocardiography
eczema, 44
EEG see electroencephalography
eflornithine cream, 193
electret-mediated drug delivery, 155–9
concepts and definitions, 155–6
cutaneous drug delivery, 156–8
mechanism of permeability enhancement, 158–9
transdermal patches, 158
electrical impedance spectroscopy, 195
electrocardiography (ECG), 192–3
electroencephalography (EEG), 192–3
electronic spectroscopic techniques, 46–8
electron microscopy (EM) simulation, 61–6
electron spin resonance (ESR), 48–9
electroporation, 169–70
EM see electron microscopy
embryogenesis, 79
EMLA cream, 115
emulsions
concepts and definitions, 210–211
cosmeceuticals, 210–215
gel emulsions, 214
liquid crystal emulsions, 214–15
microemulsions, 211–12
multiple emulsions, 215
nanoemulsions, 212–13
Pickering emulsions, 214
quick-breaking emulsions, 213–14
epidermis see also stratum corneum
anatomy and physiology, 3, 5–9
intradermal vaccination, 74–5
magnetophoresis, 152–4
nanotechnology, 126–9
epinephrine, 255
erythema, 195, 200, 210
ESR see electron spin resonance
estradiol, 107
ethnicity, 19
ethosomes, 134, 217
eutonic mixtures, 25
exenatide, 172
extracellular lipid matrix, 60
ex vivo permeation and penetration testing, 252–3
fat matrix, 57, 59, 67
FDA see Food and Drug Administration
fentanyl, 115–16, 255
ferromagnetism, 150
FFA see free fatty acids
fibrous matrices, 229
Fick’s first law, 12, 100, 108–9
filaggrin, 8
film-forming systems, 97–107
advantages for drug delivery, 99–101
advantages for patient use, 105
chemical penetration enhancers, 103–5
concepts and definitions, 97–8, 116–17
design considerations, 98–9
pump sprays and aerosols, 98–9, 105–6
supersaturation, 99–100, 101–4
therapeutic applications, 105–7
FLIM see fluorescence lifetime imaging
fluorescein isothiocyanate (FITC)-labelled
dextran, 157
fluorescence lifetime imaging (FLIM), 47
fluorescence spectroscopy, 46
foams, 229–30
Food and Drug Administration (FDA), 243,
248, 252, 255
formulation, 248–50
Franz diffusion cell, 152–3, 251–2
free fatty acids (FFA), 57, 59, 67
FTIC see fluorescein isothiocyanate
fullerenes, 137, 228
gel emulsions, 214
gene silencing, 186
glass microneedles, 192
glucose monitoring, 192
gold nanoparticles, 153–4
haemoglobin, 150
hair follicles
anatomy and physiology, 2–3, 4
nanotechnology, 127, 131, 137
heated systems, 107–17
chemical penetration enhancers, 113
concepts and definitions, 97, 107, 116–17
dermal clearance, 111–12
effects of heat on drug permeation, 112–13
effects of heat on skin, 110–111, 114–15
mechanisms of drug penetration
enhancement, 107–8
partitioning, 108–9
strategies for generating heat, 113–15
therapeutic applications, 115–16
thermophoresis, 107–8, 113–15, 117
heat shock proteins (HSP), 116
helper T cells, 85–7
HFA see hydrofluoroalkanes
high-intensity ultrasound, 167
high-pressure gas or liquid microporation, 164–6
HIV see human immunodeficiency virus
hollow microneedles, 180–182, 190, 192
horny layer see stratum corneum
HPC see hydroxypropyl cellulose
HSP see heat shock proteins
human immunodeficiency virus (HIV), 190
hyaluronic acid, 188, 193
hydration, 17, 21
hydrocortisone, 112, 224
hydrofluoroalkanes (HFA), 99, 110
hydrogel-forming microneedles, 187, 196
hydroxypropyl cellulose (HPC), 102
hypodermis, 1–2
ibuprofen sodium, 187
ICD see irritant contact dermatitis
ICDRG see International Contact Dermatitis
Research Group
ICH see International Conference on
Harmonisation
IFN see interferons
IL see interleukins
IM see intramuscular
impedance, 44
impedance spectroscopy (IS), 49
inactivated vaccines, 72
inducible regulatory T cells (iTregs), 87
infection, 196–7
influenza, 76, 188–91
infrared (IR) spectroscopy, 42–5
in situ biomolecular structure determination,
58–65
insulin
microneedles, 185–7, 192, 196–7, 200
microporation, 164–7, 169, 173
nanotechnology, 135
interferons (IFN), 80, 85–7
interleukins (IL), 85–7
International Conference on Harmonisation
(ICH), 248–9, 254
International Contact Dermatitis Research
Group (ICDRG), 244
intracutaneous delivery, 10–11
intradermal delivery
cosmeceuticals, 209–41
emulsions, 210–215
foams, 229–30
future directions, 230–231
microneedles, 186, 193
patches, 230
solid particulate systems, 222–9
vesicular systems, 216–22
intradermal vaccination, 71–95
concepts and definitions, 71–2
dendritic cells immunobiology, 73–4
dermal dendritic cell network, 77–9
disadvantages of conventional vaccination, 72–3
DTR-DT depletion system, 82–4
human dendritic cells in the skin, 80–81
Langerhans cells, 73, 76–84
Langerin-DTR mouse models, 83–4
role of skin in vaccine delivery, 75–6
skin anatomy and physiology, 74–5
skin dendritic cell network, 76–82
skin-draining lymph nodes, 73–4, 76–80
T cell differentiation, 84–7
transdermal immunisation, 81–2
intramuscular (IM) injection, 72, 188, 190
intranasal delivery, 190
in vitro drug release/dissolution studies, 251–2
in vitro fertilisation (IVF), 170
ionisation, 15–16
ion pairing, 24
iontophoresis
combinational approaches, 172–3, 187
concepts and definitions, 26–8, 168–9
product/device development, 255
IPM see isopropyl myristate
IR see infrared
irritant contact dermatitis (ICD), 195
irritation, 195–6, 200, 221
IS see impedance spectroscopy
ISIS see isostearyl isostearate
isoelectric point, 28
isopropyl myristate (IPM), 43–4, 103–4, 109
isostearyl isostearate (ISIS), 43–4
iTregs see inducible regulatory T cells
IVF see in vitro fertilisation
Janus-type dendrimers, 131–2, 220
keratin filament matrix, 67–8
keratinocytes, 14, 76
ketoprofen, 187
killed vaccines, 72
lamellar phase, 8–9, 60
Langerhans cells (LC), 73, 76–84
langerin, 76–84
laser confocal Raman spectroscopy (LCRS), 46
laser-induced breakdown spectroscopy (LIBS), 49
laser microporation, 170–171
LC see Langerhans cells
LCRS see laser confocal Raman spectroscopy
LDA see linear discriminant analysis
LH see lidocaine hydrochloride
LIBS see laser-induced breakdown spectroscopy
lidocaine
heated systems, 111, 113, 115
microporation, 169
product/device development, 255
lidocaine hydrochloride (LH), 152–3, 154
linear discriminant analysis (LDA), 46
lipid-based nanocarriers see vesicular systems
lipid bilayers
absorption, 13–14
anatomy and physiology, 7–8
chemical penetration enhancers, 23
heated systems, 110–111
nanotechnology, 126
lipid:polycation:pDNA (LPD) complexes, 29–30
α-lipoic acid, 215
liposomes, 130, 134–5, 138, 216–21
liquid crystal emulsions, 214–15
live-attenuated vaccines, 71–2
LN see lymph nodes
long periodicity phase (LPP), 9, 110
low-intensity ultrasound, 167
LPD see lipid:polycation:pDNA
LPP see long periodicity phase
lycopene, 212
lymph nodes (LN), 73–4, 76–80
macromolecules
microneedles, 185–7
microporation, 165, 170, 174
transdermal drug delivery, 148
magnetic nanoparticles, 135–6, 138, 150–151
magnetophoresis, 150–155
concepts and definitions, 150–151
drug delivery applications, 151–2
mechanism of permeability enhancement, 152–4
transdermal patches, 154–5
major histocompatibility complex (MHC), 73–4, 76–7, 80, 85–7
MALDI-MS see matrix-assisted laser desorption ionisation mass spectrometry
mannitol, 153
marinosomes, 219
mass spectrometry (MS) imaging, 50
matrix-assisted laser desorption ionisation mass spectrometry (MALDI-MS), 50
MDS see multiwalled delivery systems
mechanical nocireceptors, 5
mechanoreceptors, 4–5
Meissner’s corpuscles, 4
melanosponges, 224
meloxicam, 158
melting point, 15
MEMS see microelectromechanical systems
metallic nanoparticles, 130, 135–7, 138
metal microneedles, 183–4, 186, 189–92
methyl salicylate, 156–7
metronidazole, 186–7
Meyer–Overton theory, 13
MHC see major histocompatibility complex
microelectromechanical systems (MEMS), 182
microemulsions, 211–12
microjet injectors, 165
micromoulding technique, 184–5
microneedles (MN), 179–208
acceptability to patients and healthcare providers, 197
combinational approaches, 173–4, 187
commercial systems, 180, 200–201
concepts and definitions, 29–30, 179–82
cosmeceuticals, 193
design considerations, 180–182
drug delivery applications, 185–94
effects on the skin, 194–5
future directions, 198–9
manufacturing considerations, 199
materials and fabrication, 182–5
microporation, 173–4, 187, 194–5
patient factors, 194–8
patient safety, 196–7
regulatory considerations, 199–200
self-application, 197–8, 200
skin anatomy and physiology, 179–80
therapeutic drug monitoring, 192–3
vaccination, 188–91
microparticles, 222–4
microcapsules, 222
microspheres, 222–43
microsponges and melanosponges, 224
solid lipid microparticles and unispheres, 223–4
microporation, 163–78
concepts and definitions, 164
effects on skin, 165, 167, 169
electroporation, 169–70
high-pressure gas or liquid microporation, 164–6
iontophoresis, 168–9, 172–3
laser microporation, 170–171
microneedles, 173–4, 187, 194–5
radiofrequency microporation, 172–3
skin anatomy and physiology, 163–4
thermal microporation, 171–3
ultrasound microporation, 166–7
mineral nanoparticles, 130, 135–7
minoxidil, 133
MLM see multiphoton laser microscopy
MN see microneedles
mobile universal surface explorer (MOUSE), 48
molecular model building, 66
molecular size and shape, 14–15
MOUSE see mobile universal surface explorer
MS see mass spectrometry
MS/MS see tandem mass spectrometry
multiphoton laser microscopy (MLM), 47
multiple emulsions, 215
multi-use nozzle jet injectors (MUNJI), 164–5
multiwalled delivery systems (MDS), 221–2
MUNJI see multi-use nozzle jet injectors
myelinated fibres, 3–4
naltrexone, 151–4, 187
nanostructured lipid carriers (NLC), 135, 138, 226–8
nanotechnology, 125–46
carbon-based nanomaterials, 130, 137
concepts and definitions, 125
cosmeceuticals, 210–211, 212–13, 225–8, 231
interactions of nanoparticles with the skin, 137–8
limitations for skin delivery, 138–9
lipid-based nanocarriers, 130, 134–6, 138
magnetophoresis, 150–151, 153–4
metallic and mineral nanoparticles, 130, 135–7, 138
microneedles, 29–30
nanocarriers for topical and transdermal delivery, 129–37
nanoemulsions, 212–13
physicochemical characteristics of nanoparticles, 129
polymeric nanoparticles, 130–134, 137–8
sites for nanoparticle delivery, 127–8
skin as a barrier for nanoparticle penetration, 128–9
skin structure, 126–7
solid nanoparticles, 225–8
vesicles, 25–6
natural biopolymers, 133–4
natural moisturising factor (NMF), 21
NCE see new chemical entities
near infrared (NIR), 44
new chemical entities (NCE), 243–4
nicotine, 111–12
niosomes, 134, 221
NIR see near infrared
nitroglycerine ointment, 147–8
NLC see nanostructured lipid carriers
NMF see natural moisturising factor
NMR see nuclear magnetic resonance
nociceceptors, 5
nonionic surfactants, 22–3
nonsteroidal anti-inflammatory drugs (NSAID), 186
non-volatile solvents, 98–9, 103

NSAID see nonsteroidal anti-inflammatory drugs

nuclear magnetic resonance (NMR) spectroscopy, 47–8

occlusion, 17, 227–8

OCT see optical coherence tomography

oleic acid, 22–3, 49, 103

optical coherence tomography (OCT), 194–5, 198

opto-thermal transient emission radiometry (OTTER), 48

orthorhombic-hexagonal transition, 110–111

OTTER see opto-thermal transient emission radiometry

ovalbumin antigen, 132–3

oxybutynin, 104

Pacinian corpuscles, 4

PAMAM see poly(amido)amine

paramagnetism, 150

parathyroid hormone (PTH), 169–70, 186–7

particulate delivery, 29

partitioning, 13–14, 108–9

PAS see photoacoustic spectroscopy

PAT see process analytical technologies

patches

cosmeceuticals, 230

electret-mediated drug delivery, 158

film-forming systems, 97, 99, 105

heated systems, 111, 113–16

magnetophoresis, 154–5

microneedles, 193

microporation, 169, 171–2

product/device development, 255

PCM see phase change materials

pDC see plasmacytoid dendritic cells

PDMS see polydimethyl siloxane

PEG see polyethylene glycol

PEMF see pulsed electromagnetic fields

performance testing, 250–253

compendial methods for drug release, 251

ex vivo permeation and penetration testing, 252–3

in vitro drug release/dissolution studies, 251–2

permeability coefficient, 14–15, 156

permeation and penetration testing, 252–3

pH

absorption, 15–16

isolectric point, 28

nanotechnology, 128

phase change materials (PCM), 114

phonophoresis, 28, 166–7

phospholipids, 24

photoacoustic spectroscopy (PAS), 50

photodynamic therapy, 133

photolithography, 182–3, 185

photosomes, 218

photostability, 212

phytosomes, 219

Pickering emulsions, 214

pilosebaceous units, 126–7

pimecrolimus, 244

plasmacytoid dendritic cells (pDC), 73, 80

plasticisers, 99, 158

poly α-esters, 132–3

poly(amide)amine (PAMAM) dendrimers, 130–132

polydimethyl siloxane (PDMS), 153–4

polyethylene glycol (PEG), 104–5

polymeric microneedles, 185, 188–9

polymeric nanoparticles, 130–134, 137–8

polymer micromachining, 182

polyvinylpyrrolidone (PVP), 102, 104–5

PpIX see protoporphyrin IX

pre-formulation, 248–50

prilocaine, 115

process analytical technologies (PAT), 253

process optimisation, 253

prodrugs, 24

product/device development, 243–57

analytical method validation, 253–4

commercial and regulatory considerations, 243–57

commercial future of transdermal devices, 254–5

compendial methods for drug release, 251

do dosage/device form, 246–7

drug candidate selection, 246

ex vivo permeation and penetration testing, 252–3

in vitro drug release/dissolution studies, 251–2

market growth, 243–4

performance testing, 250–253

pre-formulation and formulation/device development, 248–50

process optimisation, 253

quality target product profile, 245, 248–50, 253

scale-up, 253

size exclusion, 244–5

specification development, 253

stability testing, 254

profilaggrin, 8

propellants, 99

propofol, 156–7

propylene glycol dipelargonate (DPPG), 43–4

protoporphyrin IX (PpIX), 133
pseudo-ceramide, 215
psoriasis, 44–5, 48
PTH see parathyroid hormone
pulsed electromagnetic fields (PEMF), 151–4
pump sprays, 98–9, 105–7
PVP see polyvinylpyrrolidone
2-pyrrolidone, 22
QbD see quality by design
QD see quantum dots
Q-TOFMS see quadrupole time-of-flight mass spectrometry
QTPP see quality target product profile
quadrupole time-of-flight mass spectrometry (Q-TOFMS), 50
quality by design (QbD), 248, 253
quality control, 248–50
quality target product profile (QTPP), 245, 248–50, 253
quantum dots (QD), 136, 138
quick-breaking emulsions, 213–14
RA see rapidly adapting
radiofrequency (RF) microporation, 172–3
Raman spectroscopy, 44–7
rapidly adapting (RA) mechanoreceptors, 4–5
regulatory T cells (Tregs), 87
retinyl retinoate, 193
reverse iontophoresis, 179
RF see radiofrequency
Ruffini endings, 4
SA see slowly adapting
salbutamol sulphate, 151
salicylic acid, 147, 156–7
SAT see sodium acetate trihydrate
scale-up, 253
scanning electron microscopy (SEM), 159, 170–171
Scientific Committee on Consumer Products (SCCP), 127–8
sebaceous glands, 2–3
sebum, 3, 21
self-application, 197–8, 200
SEM see scanning electron microscopy
sensory systems, 3–5
short periodicity phase (SPP), 110
silicone vesicles and matrices, 220–221
silicon microneedles, 182–4
siRNA see small interfering ribonucleic acid
size exclusion, 244–5
skin appendages, 2–3, 126–7
skin condition, 16–17
skin-draining lymph nodes, 73–4, 76–80
skin graft adherence, 194
SLN see solid lipid nanoparticles
slowly adapting (SA) mechanoreceptors, 4–5
small interfering ribonucleic acid (siRNA), 186
smallpox, 71
sodium acetate trihydrate (SAT), 114
sodium ascorbyl phosphate, 212
solid lipid microparticles, 223–4
solid lipid nanoparticles (SLN), 135, 138, 226–8
solid microneedles, 180–184, 186, 189–90
solid nanoparticles, 225–8
nanocapsules, 225
nanocrystals, 228
nanospheres, 225–6
solid lipid nanoparticles and nanostructured lipid carriers, 135, 138, 226–8
solid particulate systems
cosmeceuticals, 222–9
cyclodextrins, 228–9
fibrous matrices, 229
fullerenes, 228
microparticles, 222–4
solid nanoparticles, 225–8
solubility, 15
sonophoresis, 28, 166–7
Soret effect see thermophoresis
specification development, 253
spectroscopic techniques
cryo transmission electron microscopy of vitreous sections, 57–69
electret-mediated drug delivery, 159
electron microscopy simulation, 61–6
electron spin resonance, 48–9
impedance spectroscopy, 49
infrared spectroscopy, 42–5
in situ biomolecular structure determination, 58–65
interrogating skin, 41–55
in vivo studies, 48, 51
laser-induced breakdown spectroscopy, 49
mass spectrometry imaging, 50
microneedles, 194–5
molecular model building, 66
molecular organisation of the fat matrix, 67
molecular organisation of the keratin filament matrix, 67–8
native structure of skin barrier, 57–69
nuclear magnetic resonance spectroscopy, 47–8
observed data versus simulated data, 66
opto-thermal transient emission radiometry, 48
photoacoustic spectroscopy, 50
Raman spectroscopy, 44–7
ultraviolet and fluorescence spectroscopy, 46–7
vitreous sections, 60, 65–6
sphingosomes, 221
SPP see short periodicity phase
SRS see stimulated Raman scattering
SSIM see structural similarity
stability testing, 254
sterilisation, 196–7, 199
stimulated Raman scattering (SRS), 46
Stokes–Einstein equation, 19, 107–8
stratum corneum, 3, 6–11
absorption routes and mechanisms, 9–11
anatomy and physiology, 3, 5–9
bricks and mortar model, 7–8, 10–11
chemical modulation of permeation, 20–26, 148
cosmeceuticals, 209–10
cryo transmission electron microscopy of vitreous sections, 57–66
electret-mediated drug delivery, 159
electron microscopy simulation, 61–6
film-forming systems, 103–4
heated systems, 108–11
in situ biomolecular structure determination, 58–65
intradermal vaccination, 74–5
microneedles, 179–82, 185–7, 194–6, 198, 201
microporation, 163–4, 167, 170–172
molecular model building, 66
molecular organisation of the fat matrix, 67
molecular organisation of the keratin filament matrix, 67–8
nanotechnology, 126–9, 137–9
native structure of skin barrier, 57–69
observed data versus simulated data, 66
physical modulation of permeation, 26–30, 148–9
physiological properties and absorption, 16–19
product/device development, 246–7, 252
sebum, 3
theoretical considerations, 11–16
topical and transdermal drug delivery, 20–30
transdermal permeation, 9–11
vitreous sections, 60, 65–6
stratum germinativum, 5, 7, 74–5
stratum granulosum, 6, 74–5
stratum lucidum, 6, 74–5
stratum spinosum, 5–6, 7, 74–5
structural similarity (SSIM) index, 66
subcutaneous sensory mechanism, 3–5
subcutaneous vaccination, 72
subcutis, 1–2, 75
subunit vaccines, 72
sulphorhodamine, 186
sumatriptan, 255
sunscreens, 211–12, 227–8
supercooled salts, 114
supersaturation, 25, 99–100, 101–4
surfactants, 22–3
sweat glands, 2–3, 126
swellable microneedles, 180–182, 185, 187, 191–3, 196
synthetic membranes, 251–2
tacrolimus, 244
tandem mass spectrometry (MS/MS), 50
tape stripping, 43
T cell receptors (TCR), 74
T cells
CD4+ T cell polarisation, 85–7
CD8+ T cell activation, 85
differentiation, 84–7
intradermal vaccination, 73–82, 84–8
microneedles, 188, 190
TCR see T cell receptors
TEM see transmission electron microscope
terbinafine, 216–17, 219, 226–27, 229–30
terbutaline sulphate, 151
terodine, 112
terpenes, 24
tetanus, 72
TEWL see transepidermal water loss
TGF-β see transforming growth factor β
theophylline, 186–7
therapeutic drug monitoring, 192–3
thermal microporation, 171–3
thermal nocireceptors, 5
thermophoresis, 107–8, 113–15, 117
thermoreceptors, 4–5
thermoreponsive poloxamers, 194
tight junctions, 128–9
titanium dioxide, 137, 210
α-tocopherol, 210, 212
topical delivery
applied concentration/dose, 15
chemical modulation of permeation, 20–22, 25–6
cosmeceuticals, 216–17, 219, 226–27, 229–30
electret-mediated drug delivery, 156–7
film-forming systems, 97–9, 101, 104–7
heated systems, 107–8, 111–16
historical development, 147–8
nanotechnology, 125, 127, 129–38
physical modulation of permeation, 29
product/device development, 255
skin age, 18
skin hydration and occlusion, 17
toxoid vaccines, 72
transappendageal route, 10–11, 168–9
transcellular penetration, 10–11
transdermal drug delivery
  chemical modulation of permeation, 20–26, 148
electret-mediated drug delivery, 155–9
film-forming systems, 97–8, 101, 105, 107
heated systems, 107, 111–13, 115–16
historical development, 147–8
intradermal vaccination, 81–2
macromolecules, 148
magnetophoresis, 150–155
microneedles, 29–30, 173–4, 179–208
microporation, 163–78
nanotechnology, 125–46
physical modulation of permeation, 26–30, 148–9
  product/device development, 243–57
  skin anatomy and physiology, 148, 163–4
transepidermal water loss (TEWL), 43, 110, 153, 194–5, 198
transferosomes, 134–5, 138, 217
transforming growth factor β (TGF-β), 87
transmission electron microscope (TEM), 159
Tregs see regulatory T cells
trehalose, 191
tretinoin, 226
tritiated water, 153
ultrasomes, 218
ultrasound microporation, 166–7
ultraviolet (UV) spectroscopy, 46–7
unispheres, 223–4
unmyelinated fibres, 3–4
urea, 22
UV see ultraviolet
vaccination
  concepts and definitions, 71–2
dendritic cells immunobiology, 73–4
dermal dendritic cell network, 77–9
disadvantages of conventional vaccination, 72–3
DTR-DT depletion system, 82–4
human dendritic cells in the skin, 80–81
intradermal vaccination, 71–95
Langerhans cells, 73, 76–84
Langerin-DTR mouse models, 83–4
microneedles, 188–91
microporation, 164–65
role of skin in vaccine delivery, 75–6
skin anatomy and physiology, 74–5
skin dendritic cell network, 76–82
skin-draining lymph nodes, 73–4, 76–80
T cell differentiation, 84–7
transdermal immunisation, 81–2
validation, 253–4
Van’t Hoff analysis, 108–9
vasculature, 2
vasodilation, 111–12
vehicle-dependent penetration enhancement, 19–20, 131
vesicular systems
  concepts and definitions, 25–6
cosmeceuticals, 216–22
liposomes, 130, 134–6, 138, 216–21
multiwalled delivery systems, 221–2
niosomes, 134, 221
sphingosomes, 221
viable epidermis, 5–7, 74–5, 126–9
vibrational spectroscopic techniques, 42–7
vitamins, 215, 218, 223, 228–9
volatile solvents, 98–9, 103
X-ray crystallography, 58
yeast-based liposomes, 218
zinc oxide, 128, 137, 147, 210