

Contents

*Contributor contact details* ..... xi  
*Woodhead Publishing Series in Food Science, Technology and Nutrition*.... xiii  
*About the editor*..... xxiii

**1 Present status and trends in innovations in packaging for food, beverages and other fast-moving consumer goods**..... **1**  
*N. Farmer, Consultant, UK*

1.1 Introduction..... 1  
1.2 Light-weighting, material reductions, recycling and waste initiatives ..... 2  
1.3 The flexible packaging market..... 5  
1.4 Active and intelligent packaging ..... 7  
1.5 Bioplastics packaging market ..... 10  
1.6 Recycled polyethelene terephthalate (PET) market developments ..... 11  
1.7 High performance barrier additives, materials and coatings ..... 13  
1.8 Current status of the market for glass containers, plastics containers and metal packaging..... 15  
1.9 Innovations in paper and paperboard packaging ..... 15  
1.10 Holographic images ..... 16  
1.11 Nanotechnology ..... 17  
1.12 Consumer technologies, on-line retailing and social networking ..... 18  
1.13 References..... 20

**2 Modified atmosphere packaging and other active packaging systems for food, beverages and other fast-moving consumer goods**..... **22**  
*A. Emblem, London College of Fashion, UK*

2.1 Introduction..... 22

2.2	Development of modified atmosphere packaging (MAP).....	23
2.3	Principles and applications of modified atmosphere packaging .....	25
2.4	Choosing the packaging materials and formats .....	28
2.5	Packaging operations and quality aspects.....	31
2.6	Future trends .....	32
2.7	Sources of further information.....	32
2.8	References.....	33
<b>3</b>	<b>Augmenting and securing the consumer brand experience through smart and intelligent packaging for food, beverages and other fast-moving consumer goods .....</b>	<b>35</b>
	<i>J. Plimmer, Product &amp; Image Security Foundation, UK</i>	
3.1	Introduction.....	35
3.2	Integrating 'intelligence' into labels and packaging .....	38
3.3	Intelligent packaging: integration with cell phones, camera phones and smart phones .....	44
3.4	Smart labels and their uses in authentication and in reporting on product safety .....	48
3.5	Conclusions.....	56
3.6	References.....	56
<b>4</b>	<b>Developments in plastic materials and recycling systems for packaging food, beverages and other fast-moving consumer goods .....</b>	<b>58</b>
	<i>T. A. Cooper, ARGO Group International, USA</i>	
4.1	Introduction.....	58
4.2	Major types of petrochemical-based plastic materials used for packaging food, beverages and other fast-moving consumer goods .....	59
4.3	Barrier polymers and technology.....	75
4.4	Scavenger systems .....	83
4.5	Nucleating and clarifying agents .....	84
4.6	Antimicrobials additives and coatings.....	86
4.7	Active and intelligent packaging .....	87
4.8	Rigid packaging .....	88
4.9	Flexible packaging.....	91
4.10	Sustainable packaging .....	95
4.11	Recycling of plastic packaging.....	96
4.12	Sources of further information.....	100
4.13	References.....	100

<b>5 Developments in bioplastic materials for packaging food, beverages and other fast-moving consumer goods.....</b>	<b>108</b>
<i>T. A. Cooper, ARGO Group International, USA</i>	
5.1 Introduction.....	108
5.2 Definition and rationale for bioplastics.....	109
5.3 Classification of bioplastics .....	111
5.4 Biodegradability, compostability and anaerobic digestibility.....	113
5.5 Major types of biodegradable and compostable plastics used in packaging .....	116
5.6 Biodegradable plastics processing.....	129
5.7 Major packaging uses for biodegradable and compostable plastics .....	129
5.8 Biobased plastics .....	130
5.9 Biobased polymers for packaging .....	134
5.10 Examples of adoption of biobased materials in packaging markets .....	139
5.11 Major concerns with biobased plastics .....	142
5.12 Sources of further information.....	143
5.13 References.....	144
<b>6 Innovations and trends in metal packaging for food, beverages and other fast-moving consumer goods.....</b>	<b>153</b>
<i>D. A. Abramowicz and L. Jenkins, Crown Packaging Technology, USA, K. Ambrose, I. Bucklow and T. Benge, Crown Packaging Technology, UK, B. Fields, Crown Packaging Technology, USA, G. Hughes, A. Noke, J. Bilko, A. Ioannides and C. Ramsey, Crown Packaging Technology, UK</i>	
6.1 Introduction.....	153
6.2 Manufacturing technology developments.....	154
6.3 Developments in protection and decoration .....	162
6.4 New product developments .....	169
6.5 Future trends .....	183
6.6 Conclusions.....	185
6.7 References.....	186
<b>7 Paper and paperboard innovations and developments for the packaging of food, beverages and other fast-moving consumer goods .....</b>	<b>187</b>
<i>R. Coles, RichColes Packaging Associates Limited, UK</i>	
7.1 Introduction.....	187
7.2 Package design optimisation.....	192
7.3 Brand communication through packaging.....	196
7.4 Consumer well-being, package integrity, brand authenticity and ecological packaging.....	200

7.5	Other innovations in paper and paperboard packaging .....	206
7.6	References.....	219
<b>8</b>	<b>International environmental and sustainability regulatory and legislative frameworks for the packaging of food, beverages and other fast-moving consumer goods.....</b>	<b>221</b>
	<i>G. R. Inns, PEC Partnership Limited, UK</i>	
8.1	Introduction.....	221
8.2	The environmental and sustainability regulatory and legislative framework in Europe.....	224
8.3	The environmental and sustainability regulatory and legislative framework in North America .....	227
8.4	The environmental and sustainability regulatory and legislative framework in the Asia-Pacific region.....	232
8.5	Future trends and conclusions .....	236
8.6	References.....	238
<b>9</b>	<b>Nanotechnology and the packaging of food and other fast-moving consumer goods.....</b>	<b>241</b>
	<i>B. Park, GBP Consulting Ltd, UK</i>	
9.1	Introduction.....	241
9.2	Regulatory status of nanotechnology.....	244
9.3	Issues and concerns around nanotechnology .....	248
9.4	Nano-enabled products of the future .....	250
9.5	Future trends .....	255
9.6	Conclusions.....	257
9.7	References.....	258
<b>10</b>	<b>Smart and interactive packaging developments for enhanced communication at the packaging/user interface.....</b>	<b>261</b>
	<i>P. Butler, Packaging Materials &amp; Technologies, USA</i>	
10.1	Introduction.....	261
10.2	Smart packaging – enhanced communication directly via packaging .....	264
10.3	Interactive packaging – enhanced communication via internet connectivity .....	272
10.4	Future technology and societal trends affecting brand differentiation and consumer communication .....	279
10.5	Conclusions.....	286
10.6	References.....	286

<b>11 The future: global trends and analysis for the international packaging market in relation to the speed of impact of packaging innovation and likely material changes.....</b>	<b>288</b>
<i>N. Farmer, Consultant, UK</i>	
11.1 Introduction.....	288
11.2 The consumer packaging market and the challenge of glass containers versus plastic containers.....	291
11.3 The flexible packaging market.....	293
11.4 Active and intelligent packaging developments.....	294
11.5 An overview of the bioplastics market .....	295
11.6 Biodegradable and compostable materials .....	296
11.7 Recycled PET materials – the market over the next ten years....	298
11.8 International PET developments.....	299
11.9 The growth of recycling and utilisation of waste resources .....	300
11.10 Metal packaging.....	301
11.11 Paper and paperboard market .....	304
11.12 Globalisation of business opportunities, innovations and world markets .....	307
11.13 Conclusions: market trends and usage of major packaging materials to 2020.....	310
11.14 References.....	311
 <i>Index</i> .....	 <b>313</b>

# Index

- active packaging, 7–10, 87–8, 203–4
  - anti-microbial coatings and treatments, 203
  - choosing packaging materials and formats, 28–31
    - values for barrier and other properties, 29
  - ethylene absorbers, 204
  - food, beverages and fast-moving consumer goods, 22–32
  - future trends, 32
  - insect repellents, 203
  - market, 7–8
  - packaging operations and quality, 31–2
- active tags, 39
- Aerbond system, 215
- Alexipack, 204–5
- aliphatic/aromatic copolyesters, 125–6
- aliphatic copolyesters, 125–6
- all metal 2-part closures, 175
- Amcort Rigid Plastics, 292
- amorphous polyethylene terephthalate (APET), 66
- antimicrobials additives, 86–7
- antimicrobials coatings, 86–7
- APPE, 299
- Ardagh Glass, 307
- Arrhenius kinetics, 266
- aseptic packaging, 15–16
- Asia-Pacific
  - environmental and sustainability regulatory and legislative frameworks, 232–6
    - Australia, 232–3
    - China, 233–4
    - Japan, 234
    - New Zealand, 235
    - South Korea, 235
    - Taiwan, 235–6
    - Thailand, 236
- Association of European Cartonboard and Carton Makers, 197
- ASTM D5511, 124
- ASTM D6866, 111, 131
- ASTM D6400, 113–15
- augmented reality (AR), 46, 47–8, 272
- Australian Packaging Covenant (APC), 232
- Baco Biowrap, 296
- 2D bar codes, 45, 46
- barrier coating systems, 81–2
- barrier polyamides, 78–9
- Beverage Container Act, 231
- Beverage Container Deposit and Redemption Law, 230
- Beverage Container Deposit Law IAC 4/17/02
- Beverage Container Law, 231–2
- Beverage Container Ordinance, 227
- beverage ends, 175–8
  - cost reduction, 175–7
  - drinkability/pourability, 177–8
  - improved branding/loyalty, 178
  - nomenclature, 176
  - performance requirements, 177
  - reseal ability, 177–8
- beverages
  - bioplastic packaging materials, 108–43
    - biobased materials adoption in packaging markets, 139–42
    - biobased plastics, 130–4
    - biobased plastics major concern, 142–3
    - biobased polymers, 134–9
    - biodegradability, compostability and anaerobic digestibility, 113–16
    - biodegradable and compostable plastics major types, 116–29
    - biodegradable and compostable plastics uses, 129–30
    - biodegradable plastics processing, 129
    - classifications of bioplastics, 111–13
    - definition and rationale for bioplastics, 109–11
  - consumer brand experience through smart and intelligent packaging, 35–56
  - integrating intelligence into labels and packaging, 38–48
  - overview, 35–7
  - smart labels in authentication and product safety reporting, 48–56
  - metal packaging innovations and trends, 153–85

- future trends, 183–5
- manufacturing technology developments, 154–62
- new product development, 169–82
- protection and decoration, 162–9
- modified atmosphere packaging and active packaging systems, 22–32
- choosing packaging materials and formats, 28–31
- future trends, 32
- MAP development, 23–5
- MAP principles and applications, 25–8
- packaging operations and quality, 31–2
- packaging innovation status and trends, 1–20
- active and intelligent packaging, 7–10
- bioplastics packaging market, 10–11
- consumer technologies, on-line retailing and social networking, 18–20
- flexible packaging market, 5–7
- glass, plastic containers and metal packaging, 15
- high performance barrier additives, materials and coatings, 13–15
- holographic imaging, 16–17
- light-weighting, material reductions, recycling and waste initiatives, 2–5
- nanotechnology, 17–18
- paper and paperboard packaging, 15–16
- recycled PET market developments, 11–13
- plastic packaging materials and recycling systems, 58–99
- active and intelligent packaging, 87–8
- antimicrobials additives and coatings, 86–7
- barrier polymers and technology, 75–83
- flexible packaging, 91–5
- nucleating and clarifying agents, 84–6
- petrochemical-based plastic materials, 59–75
- recycling, 96–9
- rigid packaging, 88–91
- scavenger systems, 83–4
- sustainable packaging, 95–6
- biaxially-oriented PET film, 68
- biaxially-oriented polyamide (BOPA), 71
- biaxially-oriented polyester film (BOPET), 294
- biaxially-oriented polypropylene (BOPP), 63
- Billerud FibreForm, 207
- ‘biobased’ certification standard label, 199
- biobased material, 199
- Biobased monomers, 132–4
- biobased plastics, 111–12, 130–4
- evolving feedstocks, 132
- major concern, 142–3
- measurements and certifications, 130–2
- biobased polyethylene, 135–6
- biobased polymers, 134–9
- biobased polypropylene, 135–6
- biobased polyvinyl chloride, 135–6
- biodegradable plastics, 111–12
- major packaging uses, 129–30
- major types, 116–29
- processing, 129
- BioFlex A 4100 CL, 119
- bioplastic packaging
- biobased materials adoption in packaging markets, 139–42
- biobased plastics, 130–4
- biobased plastics major concern, 142–3
- biobased polymers, 134–9
- biodegradability, compostability and anaerobic digestibility, 113–16
- biodegradable and compostable plastics major types, 116–29
- biodegradable and compostable plastics uses, 129–30
- biodegradable plastics processing, 129
- classifications of bioplastics, 111–13
- definition and rationale for bioplastics, 109–11
- market, 10–11
- compostability and biodegradability, 10
- overview, 10
- packaging materials of food, beverages and fast-moving consumer goods, 108–43
- bioplastics
- classifications, 111–13
- definition and rationale, 109–11
- BioPreferred Program, 199, 210
- Blippar, 278
- blowforming, 159
- Bonsucro, 213
- Boxal, 308
- Braskem, 12–13
- can shaping, 158–62
- metal shaping technologies comparison, 160
- shaped metal cans produced by blowforming, 159
- CaPA*, 210
- cellulose, 127–8
- cellulose-based barrier systems, 81
- cellulosic blends, 127–8
- ‘chuck’ bag, 219
- clarifying agents, 84–6
- Classification Labelling Packaging (CLP) regulations, 244
- Coalition of Northeastern Governors (CONEG), 229
- Coca-Cola, 11–12, 140–1
- combibloc, 213
- combifit, 213
- CombiSafe, 211
- combishape, 213
- compostable plastics, 90
- major packaging uses, 129–30
- major types, 116–29
- Comprehensive Procurement Guidelines, 228
- ‘consume within’ indicator, 254
- Containers and Packaging Recycling Act, 234
- Converted Flexible Packaging, 294

- cryptography, 45
- crystallite polyethylene terephthalate (CPET), 66–7
- ‘Cure-In-The-Mould’ technology, 218
- date coding system, 266
- decoration, 162–5
  - tactile finish, 165
- digital watermarking, 46, 47–8
- Dip & Squeeze pouch packaging, 93
- Direct Product Cost (DPC), 200
- dry-offset, 163
- Eastman Kodak, 209
- easy-open food can ends, 170–2
  - dry products, 171–2
  - processable foods, 170–1
- Eco-marks, 234
- Ecotainer, 210
- edible packaging, 142
- edible waste disposal, 4–5
- electroluminescence (EL), 267
- Electronic Article Surveillance (EAS), 40, 41
- Elopak, 213
- embossing, 161–2
- EN 13432, 113–15
- EN 14995, 114
- Engines of Creation, 242
- environmental and sustainability regulatory and legislative frameworks
  - Asia-Pacific, 232–6
    - Australia, 232–3
    - China, 233–4
    - Japan, 234
    - New Zealand, 235
    - South Korea, 235
    - Taiwan, 235–6
    - Thailand, 236
  - Europe, 224–7
    - Switzerland, 227
  - future trends, 236–8
  - North America, 227–32
    - regulation in Canada, 228
    - regulation in USA, 228–32
  - packaging of food, beverages and other fast-moving consumer goods, 221–38
- ethylene scavengers, 84
- ethylene-vinyl alcohol (EVOH), 76–7
- EU Directive 99/31/EC, 210
- EU Lead Market Initiative (LMI), 210
- Europe
  - environmental and sustainability regulatory and legislative frameworks, 224–7
    - Switzerland, 227
- European Glass Container Federation, 292
- expanded polylactic acid (EPLA), 122
- bioplastic packaging materials, 108–43
  - biobased materials adoption in packaging markets, 139–42
  - biobased plastics, 130–4
  - biobased plastics major concern, 142–3
  - biobased polymers, 134–9
  - biodegradability, compostability and anaerobic digestibility, 113–16
  - biodegradable and compostable plastics major types, 116–29
  - biodegradable and compostable plastics uses, 129–30
  - biodegradable plastics processing, 129
  - classifications of bioplastics, 111–13
  - definition and rationale for bioplastics, 109–11
- consumer brand experience through smart and intelligent packaging, 35–56
  - integrating intelligence into labels and packaging, 38–48
  - overview, 35–7
  - smart labels in authentication and product safety reporting, 48–56
- metal packaging innovations and trends, 153–85
  - future trends, 183–5
  - manufacturing technology developments, 154–62
  - new product development, 169–82
  - protection and decoration, 162–9
- modified atmosphere packaging and active packaging systems, 22–32
  - choosing packaging materials and formats, 28–31
  - future trends, 32
  - MAP development, 23–5
  - MAP principles and applications, 25–8
  - packaging operations and quality, 31–2
- packaging innovation status and trends, 1–20
  - active and intelligent packaging, 7–10
  - bioplastics packaging market, 10–11
  - consumer technologies, on-line retailing and social networking, 18–20
  - flexible packaging market, 5–7
  - glass, plastic containers and metal packaging, 15
  - high performance barrier additives, materials and coatings, 13–15
  - holographic imaging, 16–17
  - light-weighting, material reductions, recycling and waste initiatives, 2–5
  - nanotechnology, 17–18
  - paper and paperboard packaging, 15–16
  - recycled PET market developments, 11–13
- plastic packaging materials and recycling systems, 58–99
  - active and intelligent packaging, 87–8
  - antimicrobials additives and coatings, 86–7
  - barrier polymers and technology, 75–83
  - flexible packaging, 91–5
- Facebook, 19
- FairTrade, 198
- fast-moving consumer goods, 241

- nucleating and clarifying agents, 84–6
- petrochemical-based plastic materials, 59–75
- recycling, 96–9
- rigid packaging, 88–91
- scavenger systems, 83–4
- sustainable packaging, 95–6
- Fibreform, 204
- 'First Moment of Truth' (FMoT), 196
- flexible packaging, 91–5
  - market, 5–7
  - overview, 5
- Flextrus Paperlite packaging, 207
- foils, 52–3
- food
  - bioplastic packaging materials, 108–43
    - biobased materials adoption in packaging markets, 139–42
    - biobased plastics, 130–4
    - biobased plastics major concern, 142–3
    - biobased polymers, 134–9
    - biodegradability, compostability and anaerobic digestibility, 113–16
    - biodegradable and compostable plastics major types, 116–29
    - biodegradable and compostable plastics uses, 129–30
    - biodegradable plastics processing, 129
    - classifications of bioplastics, 111–13
    - definition and rationale for bioplastics, 109–11
  - consumer brand experience through smart and intelligent packaging, 35–56
    - integrating intelligence into labels and packaging, 38–48
    - overview, 35–7
    - smart labels in authentication and product safety reporting, 48–56
  - metal packaging innovations and trends, 153–85
    - future trends, 183–5
    - manufacturing technology developments, 154–62
    - new product development, 169–82
    - protection and decoration, 162–9
  - modified atmosphere packaging and active packaging systems, 22–32
    - choosing packaging materials and formats, 28–31
    - future trends, 32
    - MAP development, 23–5
    - MAP principles and applications, 25–8
    - packaging operations and quality, 31–2
  - packaging innovation status and trends, 1–20
    - active and intelligent packaging, 7–10
    - bioplastics packaging market, 10–11
    - consumer technologies, on-line retailing and social networking, 18–20
    - flexible packaging market, 5–7
    - glass, plastic containers and metal packaging, 15
    - high performance barrier additives, materials and coatings, 13–15
    - holographic imaging, 16–17
    - light-weighting, material reductions, recycling and waste initiatives, 2–5
    - nanotechnology, 17–18
    - paper and paperboard packaging, 15–16
    - recycled PET market developments, 11–13
  - plastic packaging materials and recycling systems, 58–99
    - active and intelligent packaging, 87–8
    - antimicrobials additives and coatings, 86–7
    - barrier polymers and technology, 75–83
    - flexible packaging, 91–5
    - nucleating and clarifying agents, 84–6
    - petrochemical-based plastic materials, 59–75
    - recycling, 96–9
    - rigid packaging, 88–91
    - scavenger systems, 83–4
    - sustainable packaging, 95–6
- Food Guidance, Compliance and Regulatory Information, 229
- food packaging
  - nanotechnology, 241–58
    - future trends, 255–7
    - issues and concerns, 248–9
    - nano-enabled products of the future, 250–5
    - regulatory status, 244–7
- food spoilage, 25–6
- Forestry Stewardship Council (FSC), 198
- Frankenstein's Food, 289
- freshness indicators, 267
- Friends of the Earth (FOE), 249
- Fulton Innovation (2011), 272
- FUSION bottle, 303
- general purpose polystyrene (GPPS), 64
- German Packaging Ordinance, 226
- Glaskin packaging barrier coating, 251
- glass containers, 15
- Global Packaging Project, 4
- Godiva, 196
- Goodmorning Technology, 266
- Graham Packaging, 308
- Green Bottle, 306
- Green Dot, 226
- Green Paper Bag, 205
- GreenBottle Limited, 194
- Greenpeace, 199
- Hazard Analysis and Critical Control Point (HACCP), 31
- HDPE bottle recycling, 99
- high-density polyethylene (HDPE), 59–60
- high-impact polystyrene (HIPS), 64
- holographic foils, 17
- holographic imaging, 16–17
  - holographic foils developments, 17

- market, 16–17
- mock-ups, 17
- HP Speciality Printing, 209
- hydroforming, 161
- Iggesund Paperboard, 192
- impact modified polypropylene, 63
- incidental nanomaterials, 243
- INCPEN, 222
- industrial nanomaterial, 246
- Ingeo PLA, 210
- Ingeo 3801X, 120
- inks
  - applications for reporting and product safety, 50–1
  - colour gradation inside a time temperature label, 51
  - applications in secure labelling and packaging, 49–50
- InnoMould injection moulded pot, 197–8
- Innovia, 279, 297
- intelligent packaging, 7–10, 87–8
  - cell, camera and smart phones, 44–8
  - future trends, 47–8
  - consumer brand experience for food, beverages and other fast-moving consumer goods, 35–56
  - integrating intelligence into labels and packaging, 38–44
  - anti-theft functionality, 40–1
- market, 7–8
- overview, 35–7
  - attributes, 36
  - difference with smart packaging, 36
  - functions and delivery mechanisms, 37
  - managing product identification, 36–7
- interactive packaging, 263
  - augmented reality (AR), 272–3
  - enhanced communication via Internet connectivity, 272–9
  - smart phone/tablet-based augmented reality, 277–9, 280
    - AR on an iPad, 280
    - Moo Vision, 278
  - webcam-based augmented reality, 273–7
    - AR using the packaging of Nestlé cereal product, 274
    - coded hand card printed on the back of cereal pack, 276
    - components of 3D AR, 277
- internal coatings, 166–9
  - future trends, 169
  - material choice, 168–9
  - role, 166–7
- International Hologram Manufacturers Association (IHMA), 309
- international packaging market
  - active and intelligent packaging developments, 294–5
  - biodegradable and compostable materials, 296–8
  - compostable confectionery wrapper, 296–7
  - first biodegradable cling film, 296
  - polyhydroxyalkanoate (PHA) materials, 297–8
  - polylactic acid (PLA), 297–8
- bioplastics market overview, 295–6
- consumer packaging market and challenge of glass vs plastic containers, 291–3
- flexible packaging market, 293–4
  - material developments, 294
- global trends and analysis, 288–311
  - augmented reality technology and quick response codes, 291
  - consumer technologies, 289–90
  - GM foods, 289
  - nanotechnology, 289
  - packaging and digital print, 290
  - packaging design and digital technology, 290
  - research and development, 290–1
- globalisation of business opportunities, innovations and world markets, 307–10
- Chinese market expansion, 309–10
- major international groups getting bigger, 307–9
- growth of recycling and utilisation of waste resources, 300–1
  - need for consensus across complete packaging supply chain, 301
  - UK Government/DEFRA recycling rates 2013–2017, 300–1
- international PET developments, 299–301
- market trends and usage of major packaging materials to 2020, 310–11
  - flexible packaging, 310
  - glass container packaging, 310
  - metal packaging, 311
  - paperboard packaging, 310
  - rigid plastic containers, 310
- metal packaging, 301–4
  - BPA replacement, 304
  - market for aluminium bottles, 303
  - market overview, 301–2
  - new concepts, 303–4
  - world market opportunities, 302–3
- paper and paperboard market, 304–7
  - aseptic packaging developments, 305
  - cartonboard safety concerns, 305
  - demand growth at a slower rate, 306
  - market overview, 304
  - new markets for cardboard, 306–7
  - recycled PET materials, 298–9
- Intrinsiq, 254
- ionomers, 73–4
- ISO14001, 206
- item level coding, 38
- ‘Its Fresh!’, 204, 295
- Japan Packaging and Containers Recycling Association, 234

- lenticular label, 264
- 'Lifestyle of Health and Sustainability' (LOHAS), 194
- LightCap 30 screw cap, 213
- linear low-density polyethylene (LLDPE), 60–1
- low-density polyethylene (LDPE), 61
- manufactured nanomaterials, 243
- Mater-bi, 210
- mechanical recycling, 96–7
- MERCOSUR countries, 302
- Metabolix, 297
- metal packaging, 15
  - future trends, 183–5
    - manufacturing and material technologies, 184–5
    - manufacturing flexibility, 183–4
    - packaging fabrication sustainability, 184
    - shelf image/shelf presence and point of sale, 183
  - innovations and trends for food, beverages and fast-moving consumer goods, 153–85
  - new product development, 169–82
  - protection and decoration, 162–9
- metal packaging manufacturing, 154–62
  - general manufacturing, 155–8
    - 2-piece DRD can body construction, 156
    - 2-piece DWI can body construction, 157
    - container construction, 155–7
    - emerging can formats, 158
    - manufacturing trends, 157
    - material trends, 155
    - metal choice, 155
- metal-plastic composite closures, 174–5
- metal vacuum closure, 172–5
  - design comparison, 173
  - uses, application and benefits, 174
- Ministry of Economy, Trade and Industry (METI), 247
- Mirafoil liquid coating technology, 196
- Mirel, 297
- Mirri, 200
- MirriNor, 200
- 'Mobile Moment of Truth' (MMoT), 196
- modified atmosphere packaging (MAP), 8, 204–5
  - choosing packaging materials and formats, 28–31
  - values for barrier and other properties, 29
- development, 23–5
  - key reasons, 23–4
  - market, 23
  - negative factors, 24–5
- food, beverages and fast-moving consumer goods, 22–32
- future trends, 32
- packaging operations and quality, 31–2
- principles and applications, 25–8
  - gases, 26–7
- Moiré pattern, 264
- Moo Vision, 277
- multi-die necking, 162
- mushroom-based packaging, 142
- NanoBioMatters, 253
- NanoChromics Display (NCD), 254
- NanoChromics technology, 254
- nanocodes, 247
- nanocomposite coating systems, 82–3
- nanomaterial, 243
- nanotechnology, 17–18, 242–4
  - active materials, 252–3
    - antimicrobials, 252
    - controlled released packaging, 253
    - oxygen scavenging materials, 253
    - UV absorbers, 252–3
  - future trends, 255–7
    - food and beverage packaging, 256
    - market forecasts and views from market analysis, 255
    - pharma packaging, 256–7
    - issues and concerns, 248–9
      - House of Lords report, 248–9
      - non-governmental organisations (NGO) views, 249
  - limitations of existing packaging, 242
- market, 17–18
- nano-enabled products of the future, 250–5
  - barrier layers, 252–2
  - decorative applications, 252
  - intelligent or smart packaging, 253–4
  - nanocellulose, 251–2
  - nanocomposites, 250
  - nanoparticle migration, 255
- packaging of food and other fast-moving consumer goods, 241–58
- regulatory status, 244–7
  - Australia, 246
  - China, 246–7
  - Europe, 244
  - Japan, 247
  - nanocodes, 247
  - US, 244–6
- National Association for Shoplifting Preventions (NASP), 195
- National Environment Protection Measure (NEPM), 232, 233
- National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 246
- NATIVIA, 121
- natural nanomaterials, 243
- Natureflex, 210
- Near Field Communications (NFC), 42–3, 46
- Nestlé, 12–13
- new product development, 169–82
  - new metal packaging concepts, 178–82
    - beverage end innovations, 179
    - floating widget, self-heating and self-chilling can, 180
  - packaging success, 182

- North America
  - environmental and sustainability regulatory and legislative frameworks, 227–32
  - regulation in Canada, 228
  - regulation in USA, 228–32
    - California, 230
    - Connecticut, 230
    - Delaware, 230
    - Florida, 230
    - Hawaii, 230
    - Iowa, 231
    - Maine, 231
    - Massachusetts, 231
    - Michigan, 231
    - Minnesota, 231
    - New York, 231
    - North Carolina, 231
    - Oregon, 231
    - Vermont, 231–2
  - nucleating agents, 84–6
- O2 Block, 253
- on-line retailing, 18–20
- Organic Electronics Association (OE-A), 202
- organic recycling, 113
- oxygen scavengers, 83–4
- PA-6, 70–1
- PA-6, 6, 70–1
- packaging
  - active and intelligent packaging, 7–10
  - bioplastics packaging market, 10–11
  - consumer technologies, on-line retailing and social networking, 18–20
  - multi-channel world, 20
  - overview, 18–19
  - flexible packaging market, 5–7
  - glass, plastic containers and metal packaging, 15
  - high performance barrier additives, materials and coatings, 13–15
  - market, 13
  - PET container market development, 13–14
  - plastic container barrier technology market development, 14–15
  - holographic imaging, 16–17
  - light-weighting, material reductions, recycling and waste initiatives, 2–5
    - British retail consortium/retailer initiative, 4
    - holistic approach, 2–3
    - UK first mixed plastics recycling facility, 3–4
  - waste and recycling, 3
  - nanotechnology, 17–18
  - paper and paperboard packaging, 15–16
    - overview, 15
  - recycled PET market developments, 11–13
  - status and innovation for food, beverages and fast-moving consumer goods, 1–20
- Packaging Environmental Indicator (PEI), 223
- Packaging Product Stewardship Scheme, 235
- packaging/user interface
  - future and social trends affecting brand differentiation and consumer communication, 279–86
  - augmented reality a future reality, 281
  - electronic smart packaging, 285
  - packaging and smart devices, 281–6
  - promise of printed electronics, 279, 281
  - status of augmented reality and interactive packaging as of October 2011, 282–3
- smart and interactive packaging developments
  - for enhanced communication, 261
  - brands feeling the pinch, 263
  - interactive packaging – enhanced communication via Internet connectivity, 272–9
  - need for clearer communication, 262
  - smart or interactive packaging, 263–4
  - smart packaging – enhanced communication directly via packaging, 264–72
  - state of the current packaging/user interface, 262
- Pantene, 12
- paper and paperboard packaging
  - apparent per capita consumption in 2000 and 2010, 191
  - brand communication through packaging, 196–200
    - certification schemes, 198–9
    - retail ready packaging (RRP), 199–200
  - consumer well-being, package industry, brand authenticity and ecological packaging, 200–6
  - active packaging, 203–4
  - biodegradable and compostable packaging, 205–6
  - modified atmosphere packaging (MAP), 204–5
  - security packaging, 201
  - smart or intelligent packaging, 201–2
- design for the consumer, 193–4
- pack usability, 193–4
- trend towards 'green' consumerism, 194
- drivers of innovation, 188–9
- eco-innovation for sustainable future, 192
- global trends in consumption and market demand, 191
- innovations and developments, 187–219
- other innovations, 206–19
  - biobased materials used with paper-based packaging, 209–10
  - corrugated fibreboard packaging, 213–14
  - digital printing, 208–9
  - folding cartons, 214–15
  - innovative barrier solutions against mineral oil hydrocarbon (MOH) residues, 207–8
  - micro-crêping, 207
  - micro-fibrillated cellulose technology, 207
  - moulded pulp containers, 218

- paper bags, 218–19
- paper-based composite cans, 217–18
- paper-based flexible packaging, 215–17
- retortable, aseptic and chill preservation treatments, 210–13
- package design optimisation, 192–6
  - design for the environment, 195–6
  - design for the supply chain, 194–5
- packaging design – brand perception, 196–8
- in-mould labelling (IML), 197–8
- pressure-sensitive self-adhesive (PSA) labelling, 198
- sustainability, 189–90
- trends in production, 190–1
  - world production, 190
  - world production percentage by region between 2002 and 2010, 190
- paper packaging, 15–16
- paperboard packaging, 15–16
- passive tags, 39
- 'Pay as You Throw' scheme, 228
- pearl effect, 252
- peelable foil ends, 171
- PepsiCo, 11–12, 141
- PET beer keg, 299
- PET bottle recycling, 97–9
- PET copolymers, 67–8
- PET processing, 68–9
- Petainer, 299
- petrochemical-based plastic materials, 59–75
  - ethylene-vinyl acetate copolymers (EVA), 73
  - ionomers, 73–4
  - polyamides (nylons), 70–1
  - polyesters, 65–9
  - polyethylene, 59–61
  - polypropylene (PP), 61–3
  - polystyrene (PS), 63–5
- Physically Unclonable Functions (PUF), 41
- PlantBottle, 11–12, 140–1
  - biobased polyethylene terephthalate, 141
- Plantic, 10–11
- PlasmaPlus coating technique, 251
- plastic containers, 15
- plastic packaging, 30
  - active and intelligent packaging, 87–8
  - antimicrobials additives and coatings, 86–7
  - barrier polymers and technology, 75–83
  - flexible packaging, 91–5
  - materials and recycling systems in food, beverage and fast-moving consumer goods, 58–99
  - nucleating and clarifying agents, 84–6
  - petrochemical-based plastic materials, 59–75
  - recycling, 96–9
  - rigid packaging, 88–91
  - scavenger systems, 83–4
  - sustainable packaging, 95–6
- polybutylene adipate-co-terephthalate (PBAT), 125
- polybutylene succinate adipate (PBSA), 125
- polybutylenesuccinate (PBS), 125
- polycaprolactone (PCL), 125
- polycarbonate, 69–70, 141–2
- polyesters, 136–7
- polyethylene furanoate (PEF), 138
- polyethylene terephthalate (PET), 65–7
  - container market development, 13–14
- polyglycolic acid (PGA), 79–80
- polyhydroxyalkanoates (PHA), 123–5
  - polymerisation, 123
  - structure properties and processing, 123–5
- polylactic acid (PLA), 11, 117–23
  - packaging applications, 121–3
  - polymerisation, 117–18
  - processing and properties, 118–21
  - production, 118
- polymer coating, 165–6
  - applications, 166
  - manufacturing routes, 165–6
- polypropylene, 197
- polypropylene copolymer, 62–3
- polypropylene homopolymer, 62
- polystyrene foams, 65
- polyvinyl alcohol (PVOH), 74–5, 128–9
- polyvinyl chloride (PVC), 71–2
- polyvinylidene chloride (PVdC), 77–8
- pouch packaging, 92–4
- pouch packs, 6–7
- Pragmatic Printing, 279
- press-on twist-open closures, 174
- printed electronics, 279
- printegration, 254
- printing, 162–5
  - 2-piece can printing (post-forming), 164
- Pro Europe s.p. r.l. Packaging Recovery Organisation, 226
- Procter and Gamble, 12
- Producer Responsibility Law No. 106 of 2005, 235
- 'Product Stewardship,' 227
- Product Stewardship Framework Law HP1159, 231
- Programme for the Endorsement of Forest Certification (PEFC), 199
- protein-based barrier systems, 81
- protein-based bioplastics, 128
- Pure-Pak, 212
- Pure-Pak Curve, 213
- quick response (QR) code, 45, 263
- Qwak Smack, 278
- radio frequency identification (RFID), 36, 38–40, 40–1
  - brand protection, 41–2
  - tamper evident functions, 42
  - different frequencies and applications, 39
  - packaging and labelling conversion, 43–4
  - public domain, 42–3
  - tag in label format, 40

- Rainforest Alliance, 198, 199
- randomisation, 45–7
- recycled polyethylene terephthalate (rPET), 66
  - market developments, 11–13
- refrigeration, 211
- renewable sourcing, 110
- Resource Conservation and Recovery Law 42
  - USC 6901, 228
- Responsible NanoCode, 247
- Restriction of Chemicals Implementation
  - Project on Nanomaterials (RIPoN), 244
- retail-ready packs, 16
- retort shock, 89
- retortable paperboard-based carton systems, 211–12
- retorting, 89
- Returnable Beverage Container Law, 231
- Rexam Consumer Packaging Report, 301, 304
- rheofforming, 161
- rigid packaging, 88–91
  - sustainability improvements, 88
- Rigid Plastic Packaging Container (RPPC) Law, 230
- Sanocoat, 203
- Sappi Paper and Packaging, 205
- SBS block copolymer thermoplastic elastomers, 64–5
- sealing can ends, 167–8
- sealing closures, 168
- sealing compounds, 167–8
- shape memory polymers (SMP), 55
- sheet offset lithography, 163
- ‘shopper’ bag, 219
- shrink wrap, 94–5
- silver, 252
- smart labels
  - authentication and product safety reporting, 48–56
    - future trends, 54–6
    - tamper evidence, 53–4
- smart or intelligent packaging, 201–2
  - colour change labels, 202
  - radio frequency identification (RFID) labels and tags, 202
- smart packaging, 263
  - animated graphics
    - lenticular label on eye-make up kit, 265
    - moving soundwave as the user pulls out the outer transparent sleeve, 266
    - using lenticular labels, 264
    - using Moiré effects, 264–6
  - colour-change labels for freshness and ripeness alerts, 266–7
  - consumer brand experience for food, beverages and other fast-moving consumer goods, 35–56
  - electronic animated graphics and sound on packaging, 269–72
  - electronic animated lighting effects on packaging, 267–9, 270, 271
  - electroluminescent label on whisky bottle, 270
  - Fresh-Check time-temperature indicator labels, 268
  - front of packaging for Concorde pears with active ripeness indicator, 269
  - NXT shaving products for men in triangular plastic container with intermittent LED lighting, 271
  - electronic animation with integrated wireless power, 272, 273
  - back-lit electroluminescent parts of cereal graphic, 273
  - enhanced communication directly via packaging, 264–72
  - overview, 35–7
    - attributes, 36
    - difference with intelligent packaging, 36
    - functions and delivery mechanisms, 37
    - managing product identification, 36–7
  - smart labels in authentication and product safety reporting, 48–56
- Smurfit Kappa, 200
- social networking, 18–20, 47–8
- Society of the Plastics Industry, 230
- South Korea Recycling Law Ministry of
  - Environment Notification No. 2002–195, 235
- starch-based barrier systems, 80–1
- starch blends, 126–7
- steam venting systems, 6
- stick pack, 94
- Stora Enso, 205, 207
- stretch forming, 161
- stretch wrap, 94
- Sun Capital Partners, 308
- Surlyn, 217
- sustainable packaging, 95–6
- Sustainable Packaging Coalition (SPC), 228
- ‘Tapje’ keg, 299
- terephthalic acid, 137–8
- Tetra Brik Aseptic, 212
- Tetra Brik Aseptic 1000 Edge, 212
- Tetra Brik Aseptic Edge carton, 212
- Tetra Evero Aseptic, 212, 305
- Tetra Pak, 12–13
- Tetra Pisma Aseptic carton, 212
- Tetra Recart, 211
- thermochromic ink technology, 9–10
- thermoformed packaging, 89
- thermoplastic starch, 126–7
- thin-wall packaging, 89–91
- time temperature indicators (TTI), 8–9, 267
- titanium dioxide, 253
- Tone, 210
- Toxic Substances Control Act (TSCA), 245
- Toxics in Packaging Clearing House (TPCH), 229

## 322 Index

twist-open closures, 172  
  schematic diagram, 173  
Twitter, 18–19

UK Forestry Standard, 199  
universal product classification (UPC), 38

vacuum packaging, 28  
Vissiongain, 255

Waste Act, 236  
Waste Minimisation Act (2008), 235

Westminster Food and Nutrition Forum, 18  
Widex, 264  
WK 35342, 115  
World Wildlife Fund (WWF), 199  
wrap rage, 262

Xeikon, 209

YES Pack, 93

zinc oxide, 253  
Zipbox, 193