

NANOTECHNOLOGY: A REALISTIC MARKET ASSESSMENT



NAN031F
November 2014

Andrew McWilliams
Project Analyst

ISBN: 1-62296-001-7



BCC Research
49 Walnut Park, Building 2
Wellesley, MA 02481 USA
866-285-7215 (toll-free within the USA),
or (+1) 781-489-7301
www.bccresearch.com
information@bccresearch.com

TABLE OF CONTENTS

TOPIC	PAGE NO.
CHAPTER 1 INTRODUCTION	2
STUDY BACKGROUND	3
STUDY GOALS AND OBJECTIVES	3
INTENDED AUDIENCE	4
SCOPE OF REPORT	4
METHODOLOGY AND INFORMATION SOURCES	5
ANALYST'S CREDENTIALS	5
RELATED BCC RESEARCH REPORTS	6
BCC RESEARCH WEBSITE	7
DISCLAIMER	7
CHAPTER 2 EXECUTIVE SUMMARY	9
<i>SUMMARY TABLE GLOBAL NANOTECHNOLOGY MARKET, THROUGH 2019 (\$ MILLIONS)</i>	9
<i>SUMMARY FIGURE GLOBAL NANOTECHNOLOGY MARKET, 2013-2019 (\$ MILLIONS)</i>	9
CHAPTER 3 OVERVIEW: POTENTIAL NANOTECHNOLOGY END USERS AND APPLICATIONS	12
GENERAL DESCRIPTION OF NANOTECHNOLOGY	12
DEFINITION	12
BRIEF HISTORY OF NANOTECHNOLOGY	12
NANOTECHNOLOGY APPLICATIONS	14
NANOMATERIALS	15
<i>TABLE 1 MAJOR CATEGORIES OF NANOMATERIALS</i>	16
Solid Nanoparticles	16
General Description	16
Fabrication	17
Gas Phase Processing	17
Gas Condensation with Thermal Evaporation	17
Vacuum Evaporation on Running Liquids	18
Plasma Synthesis	18
Combustion Synthesis	18
Wet Phase Processing	18
Chemical Precipitation	18
Hydrothermal Processing	19
Sol-Gel Processing	19
Radiolysis	19
Mechanical Processing	20
High-Energy Ball Milling	20
Mechanochemical Synthesis	20
Graphene Platelets	20
Scotch Tape Method	20
Epitaxial Method	21
Graphite Oxide Reduction Method	21
Experimental Approaches	21
Types of Nanoparticles and Their Applications	22

TOPIC	PAGE NO.
Established Commercial Applications	22
<i>TABLE 2 ESTABLISHED COMMERCIAL NANOPARTICLE APPLICATIONS, 2014</i>	23
Inks and Pigments	25
Coatings and Adhesives	25
Chemical-Mechanical Polishing (CMP) Compounds	26
Sunscreens and Other Personal Care Products	26
Other UV Protection Products	26
Synthetic Bone and Tooth Enamel	27
Ferrofluids	28
Drug Delivery Vehicles	28
Fabrics and Fabric Treatments	29
Biomedical Markers and Detection Aids	30
Transfection Reagents	31
Dietary Supplements	31
Filtration Systems	32
Magnetic Separations	32
MRI Contrast Agents	33
Antioxidants	33
Surface Disinfectants	34
Diesel Fuel Additives	34
Fuel and Explosive Additives	34
Hazardous Chemical Neutralizers	34
Diode Lasers	35
Petroleum Refining	35
Synthetic Fuels Production	36
Multilayer Ceramic Capacitors	36
Printed Electronics	37
Rechargeable Lithium Ion Batteries	38
Proteomics Applications	39
Light-Emitting Diodes (LEDs)	39
Thermal Interface Materials	40
Developmental Nanoparticle Applications	40
<i>TABLE 3 DEVELOPMENTAL NANOPARTICLE APPLICATIONS, 2014</i>	41
Molecular Imaging Agents	41
Flat-Panel Displays	42
Digital Image Sensors	42
Electrochromic Displays	43
Nanosensors	43
Graphene Printed Electronics	44
Graphene Interconnections	44
Thermal Management Materials	45
Hollow Nanoparticles	45
General Description	45
Fabrication	46
Arc Discharge	46
Laser Ablation	46
Chemical Vapor Deposition	46

TOPIC	PAGE NO.
Flame Synthesis	46
Hollow Nanoparticle Applications	47
Established Commercial Applications	47
Scanning Microscope Tips	47
Nanosensors	47
Water Filtration Systems	47
Developmental Applications	48
<i>TABLE 4 DEVELOPMENTAL NANOTUBE APPLICATIONS, 2014</i>	48
Field Emission Devices	49
Drug Delivery Systems	50
Semiconductors	51
Printed Electronics	52
Computer Memory	52
Hydrogen Storage	53
Conductive Fibers	54
Batteries	54
Ultracapacitors	55
Nanoscale Thin Films and Coatings	55
General Description	55
Fabrication	55
Nanoparticulate Precursor Methods	56
Dip Coating	56
Spin Coating	56
Electrophoretic Deposition	56
Thermal Spray Coating	57
Pulsed Laser Deposition	57
Direct Production of Nanoscale Thin Film Coatings	57
Electrodeposition	57
Amorphous Crystallization	58
Nanoscale Thin Film Applications	58
Established Commercial Applications	58
<i>TABLE 5 ESTABLISHED COMMERCIAL NANOSCALE THIN FILM APPLICATIONS, 2014</i>	58
Catalytic Converters	59
Fuel Cells	60
Flat-Panel Displays	60
Nanoporous Membranes	61
Eyeglass and Other Lens Coatings	62
Antimicrobial Dressings	62
Optical Recording Media	63
Hard Disk Media and Heads	63
Magnetic Recording Tapes	63
Optical Fiber Cladding	64
High-strength Coatings (Nanostructured Steel)	64
Photocatalytic Coatings	64
Low-k Dielectric Coatings	65
Anti-Scratch/Anti-Stick Coatings	65
Electroconductive Coatings	66

TOPIC	PAGE NO.
Thermal Spray Coatings	66
Photovoltaics	67
Lighting	68
Developmental Applications	69
<i>TABLE 6 DEVELOPMENTAL NANOSCALE THIN FILM APPLICATIONS, 2014</i>	69
Transparent Electrodes	69
Nanostructured Magnetic Coatings for Medical Devices	70
Biocompatible Coatings for Medical Devices and Implants	70
Superlenses	71
Graphene Ultracapacitors	71
Thermal Spreaders	72
Nanostructured Monolithics	73
General Description	73
Fabrication	74
Consolidation of Nanoparticles into Monolithics	74
Severe Plastic Deformation	74
Aerogels	74
Nanostructured Monolithic Applications	75
Established Commercial Applications	75
<i>TABLE 7 ESTABLISHED COMMERCIAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, 2014</i>	75
High-Pressure Discharge Lamp Tubes	75
Building Insulation	76
Catalysts	76
Fuel Cell Membranes	76
Energy Recovery Ventilators	77
Nanostructured Structural Steel	77
Developmental Applications	77
<i>TABLE 8 DEVELOPMENTAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, 2014</i>	78
Medical Implants	78
Electrochemical Devices	78
Water Filtration Membranes	79
Nanocomposites	80
General Description	80
Fabrication	80
Clay/Polymer Nanocomposites	80
Carbon Nanotube Composites	81
Oriented Nanocomposite Extrusion Process	81
Layered Fabrication	82
Nanocomposite Fibers	82
Nanocomposite Applications	82
Established Commercial Applications	82
<i>TABLE 9 ESTABLISHED COMMERCIAL NANOCOMPOSITE APPLICATIONS, 2014</i>	83
Automotive Parts	83
Packaging	84
Wire and Cable Sheathing	84
Electrostatic Dissipative (ESD) Applications	85

TOPIC	PAGE NO.
Electrical and Electronic Devices	85
Sporting Goods	86
Electronics Shielding	87
Hydrophobic/Oleophobic Nanocomposites	87
Water Purification	88
Developmental Nanocomposite Applications	89
<i>TABLE 10 DEVELOPMENTAL NANOCOMPOSITE APPLICATIONS, 2014</i>	89
Nanocomposite Fuel Cell Membranes	89
Tungsten Carbide Tools	90
Protective Clothing	90
Channel Add/Drop Filters	91
Optical Switches	91
Optical Amplifiers	92
Bone Replacements and Cements	92
Conductive Fiber	93
Miscellaneous Structural Applications	93
NANOTOOLS	94
General Description	94
Nanotool Applications	94
Established Commercial Applications	94
<i>TABLE 11 ESTABLISHED COMMERCIAL NANOTOOL APPLICATIONS, 2014</i>	95
Nanomanipulators	95
Near-Field Optics	96
Nanomachining Tools	97
Advanced Optical Nanolithography Tools	97
<i>TABLE 12 ITRS TECHNOLOGY NODES, 2013-2019 (MINIMUM LINE WIDTH)</i>	98
Developmental Applications	98
Next-Generation Nanolithography Tools	99
NANODEVICES	100
General Description	100
Nanodevice Applications	100
Established Commercial Applications	100
<i>TABLE 13 ESTABLISHED COMMERCIAL NANODEVICE APPLICATIONS, 2014</i>	101
Nano-High-Performance Liquid Chromatography	101
Nanosensors	102
Drug Production and Mixing Systems	103
Developmental Nanodevice Applications	103
<i>TABLE 14 DEVELOPMENTAL NANODEVICE APPLICATIONS, 2014</i>	103
Holographic Memory	104
CHAPTER 4 PATENT ANALYSIS	106
PATENTS BY TYPE OF NANOTECHNOLOGY	106
<i>TABLE 15 U.S. NANOTECHNOLOGY PATENTS ISSUED BY TYPE, JANUARY 1, 2005 TO JULY 31, 2014 (NUMBER OF PATENTS/%)</i>	106
NANOTECHNOLOGY PATENT HOLDERS	106
<i>TABLE 16 COMPANIES AND INSTITUTIONS GRANTED THE LARGEST NUMBER OF U.S. NANOTECHNOLOGY PATENTS, JANUARY 1, 2005 THROUGH JULY 31, 2014 (NUMBER OF PATENTS)</i>	107

TOPIC	PAGE NO.
CHAPTER 5 GLOBAL MARKET FOR NANOTECHNOLOGY PRODUCTS	109
TOTAL MARKET SIZE	109
<i>TABLE 17 GLOBAL MARKET FOR NANOTECHNOLOGY PRODUCTS, THROUGH 2019 (\$ MILLIONS)</i>	109
<i>FIGURE 1 GLOBAL MARKET FOR NANOTECHNOLOGY PRODUCTS, 2013-2019 (\$ MILLIONS)</i>	110
NANOTECHNOLOGY MARKET BY TYPE OF TECHNOLOGY	110
<i>TABLE 18 GLOBAL NANOTECHNOLOGY MARKET BY TYPE OF TECHNOLOGY, THROUGH 2019 (\$ MILLIONS)</i>	110
<i>FIGURE 2 GLOBAL NANOTECHNOLOGY MARKET SHARES BY TYPE OF TECHNOLOGY, 2013 VERSUS 2019 (%)</i>	110
NANOMATERIALS	112
Total Market	112
<i>TABLE 19 GLOBAL NANOMATERIALS SALES BY TYPE, THROUGH 2019 (\$ MILLIONS)</i>	112
<i>FIGURE 3 GLOBAL NANOMATERIALS MARKET SHARES BY TYPE, 2013 VERSUS 2019 (%)</i>	112
Nanomaterials Sales by Type	114
Solid Nanoparticles	114
<i>TABLE 20 GLOBAL SOLID NANOPARTICLE MARKET BY CURRENT STAGE OF COMMERCIALIZATION, THROUGH 2019 (\$ MILLIONS)</i>	114
Established Commercial Solid Nanoparticle Applications	114
<i>TABLE 21 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL SOLID NANOPARTICLE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	115
Coatings and Adhesives	116
<i>TABLE 22 GLOBAL CONSUMPTION OF PGM POLYMER NANOPARTICLES USED IN COATINGS AND ADHESIVES, THROUGH 2019 (\$ MILLIONS)</i>	116
Ultrafine Polishing Compounds	116
<i>TABLE 23 GLOBAL TREND IN SEMICONDUCTOR SALES, THROUGH 2019 (\$ BILLIONS)</i>	117
<i>TABLE 24 GLOBAL CONSUMPTION OF SILICA AND ALUMINA NANOPARTICLES USED IN CMP COMPOUNDS, THROUGH 2019 (\$ MILLIONS)</i>	117
UV Absorbers	117
<i>TABLE 25 GLOBAL SUNSCREEN SALES, THROUGH 2019 (\$ BILLIONS)</i>	118
<i>TABLE 26 GLOBAL CONSUMPTION OF TIO2 AND ZNO NANOPARTICLES USED IN SUNSCREENS AND OTHER PERSONAL CARE PRODUCTS, THROUGH 2019 (\$ MILLIONS)</i>	118
Synthetic Bone and Tooth Enamel	119
<i>TABLE 27 GLOBAL MARKET FOR NANOPARTICLE-BASED SYNTHETIC BONE AND TOOTH ENAMELS, THROUGH 2019 (\$ MILLIONS)</i>	119
Ferrofluids	119
<i>TABLE 28 GLOBAL PRODUCTION OF ELECTRONIC DEVICES INCORPORATING FERROFLUIDS, THROUGH 2019 (MILLION UNITS)</i>	120
<i>TABLE 29 GLOBAL MARKET FOR IRON OXIDE NANOPARTICLES USED IN FERROFLUIDS, THROUGH 2019 (\$ MILLIONS)</i>	120
Drug Delivery Vehicles	120
<i>TABLE 30 GLOBAL MARKET FOR NANOPARTICLES USED TO DELIVER DRUGS, THROUGH 2019 (\$ MILLIONS)</i>	121
Fabric Treatment	122
<i>TABLE 31 GLOBAL MARKET FOR POLYMER NANOPARTICLES USED IN FABRIC TREATMENTS, THROUGH 2019 (\$ MILLIONS)</i>	122

TOPIC	PAGE NO.
Biomedical Markers and Detection Aids	122
<i>FIGURE 4 NANOPARTICLES USED IN BIOLOGICAL MARKER AND DETECTION AID APPLICATIONS, 2013 (%)</i>	122
<i>TABLE 32 GLOBAL MARKET FOR NANOPARTICLES USED AS BIOMEDICAL MARKERS AND DETECTION AIDS, THROUGH 2019 (\$ MILLIONS)</i>	124
Transfection Reagents	125
<i>TABLE 33 GLOBAL MARKET FOR DENDRIMERS USED IN TRANSFECTION REAGENTS, THROUGH 2019 (\$ MILLIONS)</i>	125
Dietary Supplements	125
<i>TABLE 34 GLOBAL MARKET FOR SILVER AND SILICA NANOPARTICLES USED IN DIETARY SUPPLEMENTS, THROUGH 2019 (\$ MILLIONS)</i>	126
Filtration Systems	126
<i>TABLE 35 GLOBAL MARKET FOR NANOPARTICULATE ALUMINA USED IN ULTRAFILTRATION APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	126
Magnetic Separations	127
<i>TABLE 36 GLOBAL MARKET FOR NANOPARTICULATE IRON OXIDE USED IN BIOMAGNETIC SEPARATION APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	127
MRI Contrast Agents	127
<i>TABLE 37 GLOBAL MARKET FOR NANOPARTICULATE IRON OXIDE USED IN MRI CONTRAST MEDIA, THROUGH 2019 (\$ MILLIONS)</i>	128
Surface Disinfectants	128
<i>TABLE 38 GLOBAL MARKET FOR OIL NANOSPHERES USED IN SURFACE DISINFECTANTS, THROUGH 2019 (\$ MILLIONS)</i>	128
Diesel Fuel Additives	128
<i>TABLE 39 GLOBAL MARKET FOR NANOPARTICULATE CERIUM OXIDE USED IN DIESEL FUEL ADDITIVES, THROUGH 2019 (\$ MILLIONS)</i>	129
Fuel and Explosive Additives	129
<i>TABLE 40 GLOBAL MARKET FOR NANOPARTICULATE ALUMINA AND IRON OXIDE FOR FUEL AND EXPLOSIVE ADDITIVES, THROUGH 2019 (\$ MILLIONS)</i>	130
Diode Lasers	130
<i>TABLE 41 GLOBAL MARKET FOR QUANTUM DOT LASER DIODES, THROUGH 2019 (\$ MILLIONS)</i>	130
Refinery Catalysts	130
<i>TABLE 42 GLOBAL MARKET FOR NANOPARTICLES USED IN PETROLEUM REFINING, THROUGH 2019 (\$ MILLIONS)</i>	131
Synthetic Fuels Production	131
<i>TABLE 43 GLOBAL MARKET FOR COAL LIQUEFACTION NANOCATALYSTS, THROUGH 2019 (\$ MILLIONS)</i>	132
Multilayer Ceramic Capacitors	132
<i>TABLE 44 GLOBAL CONSUMPTION OF NANOPARTICLES IN MULTILAYER CERAMIC CAPACITOR APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	132
Printed Electronics	133
<i>TABLE 45 GLOBAL CONSUMPTION OF SILVER NANOPARTICLES IN ELECTRONIC PRINTING INKS, THROUGH 2019 (\$ MILLIONS)</i>	133
Rechargeable Batteries	133
<i>TABLE 46 GLOBAL CONSUMPTION OF NANOPARTICLES USED IN RECHARGEABLE LITHIUM ION BATTERIES, THROUGH 2019 (\$ MILLIONS)</i>	134
Proteomics	134
<i>TABLE 47 GLOBAL CONSUMPTION OF APTAMERS FOR PROTEOMICS APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	135
Light-Emitting Diodes	135

TOPIC	PAGE NO.
<i>TABLE 48 GLOBAL CONSUMPTION OF NANOPARTICLES IN LED FABRICATION, THROUGH 2019 (\$ MILLIONS)</i>	135
Developmental Applications	136
<i>TABLE 49 GLOBAL MARKET FOR COMMERCIALY PROMISING NANOPARTICLE APPLICATIONS STILL UNDER DEVELOPMENT, THROUGH 2019 (\$ MILLIONS)</i>	136
Molecular Imaging Agents	136
<i>TABLE 50 GLOBAL CONSUMPTION OF APTAMERS FOR MOLECULAR IMAGING APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	137
Flat-panel Displays	137
<i>TABLE 51 GLOBAL CONSUMPTION OF NANOPARTICLES IN FLAT-PANEL DISPLAYS, THROUGH 2019 (\$ MILLIONS)</i>	137
Digital Image Sensors	137
<i>TABLE 52 GLOBAL CONSUMPTION OF QUANTUM DOTS IN DIGITAL IMAGE SENSORS, THROUGH 2019 (\$ MILLIONS)</i>	138
Electrochromic Displays	138
<i>TABLE 53 GLOBAL CONSUMPTION OF ELECTROCHROMIC DISPLAY MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	139
Graphene Printed Electronics	139
<i>TABLE 54 GLOBAL CONSUMPTION OF GRAPHENE FOR PRINTED ELECTRONICS APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	139
Graphene Interconnections	139
<i>TABLE 55 GLOBAL CONSUMPTION OF GRAPHENE FOR HIGH-PERFORMANCE INTERCONNECTS, THROUGH 2019 (\$ MILLIONS)</i>	140
Graphene-Filled Thermal Interface Materials	140
<i>TABLE 56 GLOBAL CONSUMPTION OF GRAPHENE FOR THERMAL INTERFACE MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	140
Nanotubes and Other Hollow Nanoparticles	140
<i>TABLE 57 GLOBAL MARKET FOR NANOTUBES AND OTHER HOLLOW NANOPARTICLES, THROUGH 2019 (\$ MILLIONS)</i>	141
Established Commercial Nanotube Applications	141
<i>TABLE 58 MARKET FOR ESTABLISHED COMMERCIAL CARBON NANOTUBE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	141
Scanning Microscope Tips	142
Developmental Applications	142
<i>TABLE 59 MARKET FOR COMMERCIALY PROMISING NANOTUBE APPLICATIONS STILL UNDER DEVELOPMENT, THROUGH 2019 (\$ MILLIONS)</i>	142
Field Emission Devices	142
<i>TABLE 60 GLOBAL CONSUMPTION OF CARBON NANOTUBE MEDICAL X-RAY TUBES, THROUGH 2019 (\$ MILLIONS)</i>	143
Semiconductors	143
Printed Electronics	144
<i>TABLE 61 GLOBAL CONSUMPTION OF CARBON NANOTUBE INKS IN PRINTED ELECTRONICS, THROUGH 2019 (\$ MILLIONS)</i>	144
Hydrogen Storage	144
Conductive Fibers	144
<i>TABLE 62 GLOBAL CONSUMPTION OF CARBON NANOTUBE CONDUCTIVE FIBERS, THROUGH 2019 (\$ MILLIONS)</i>	145
Ultrathin Batteries and Capacitors	145
<i>TABLE 63 GLOBAL CONSUMPTION OF CARBON NANOTUBE ELECTRODE MATERIALS USED IN ULTRATHIN BATTERIES AND CAPACITORS, THROUGH 2019 (\$ MILLIONS)</i>	146

TOPIC	PAGE NO.
Nanoscale Thin Films	146
<i>TABLE 64 GLOBAL NANOSCALE THIN FILM MARKET, THROUGH 2019 (\$ MILLIONS)</i>	146
Established Commercial Nanoscale Thin Film Applications	146
<i>TABLE 65 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL NANOSCALE THIN FILM APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	147
Catalytic Converters	147
<i>TABLE 66 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN CATALYTIC CONVERTERS, THROUGH 2019 (\$ MILLIONS)</i>	148
Fuel Cells	148
<i>TABLE 67 GLOBAL FUEL CELL SALES BY TECHNOLOGY TYPE, THROUGH 2019 (\$ MILLIONS)</i>	149
<i>TABLE 68 FUEL CELL CONSUMPTION OF PLATINUM THIN FILM CATALYSTS, THROUGH 2019 (\$ MILLIONS)</i>	149
Flat-Panel Displays	150
<i>TABLE 69 CONSUMPTION OF OLED THIN FILM MATERIALS, THROUGH 2019 (\$ MILLIONS/%)</i>	150
Nanoporous Membranes	150
<i>TABLE 70 GLOBAL CONSUMPTION OF NANOPOROUS THIN FILM MEMBRANES, THROUGH 2019 (\$ MILLIONS)</i>	151
Eyeglass and Other Lens Coatings	152
<i>TABLE 71 GLOBAL EYEGLASS COATING SALES, THROUGH 2019 (\$ MILLIONS)</i>	152
<i>TABLE 72 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN EYEGLASS AND OTHER OPTICAL COATINGS, THROUGH 2019 (\$ MILLIONS)</i>	152
Antimicrobial Dressings	152
<i>TABLE 73 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN ANTIMICROBIAL DRESSINGS, THROUGH 2019 (\$ MILLIONS)</i>	153
Optical Recording Media	153
<i>TABLE 74 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN OPTICAL RECORDING MEDIA COATINGS, THROUGH 2019 (\$ MILLIONS)</i>	154
Hard Disk Media and Heads	154
<i>TABLE 75 GLOBAL HARD DISK MEDIA PRODUCTION AND THIN FILM MATERIALS CONSUMPTION, THROUGH 2019</i>	154
<i>TABLE 76 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN HARD DISK MEDIA AND RECORDING HEADS, THROUGH 2019 (\$ MILLIONS)</i>	155
Magnetic Recording Media	155
<i>TABLE 77 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN MAGNETIC RECORDING MEDIA, THROUGH 2019 (\$ MILLIONS)</i>	155
Fiber Optic Cladding	156
<i>TABLE 78 GLOBAL OUTPUT OF FIBER OPTIC CABLE, THROUGH 2019 (MILLION KM)</i>	156
<i>TABLE 79 GLOBAL CONSUMPTION OF SILICA NANOMATERIALS FOR FIBER OPTIC CABLE, THROUGH 2019 (\$ MILLIONS)</i>	156
Photocatalytic Coatings	157
<i>TABLE 80 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN PHOTOCATALYTIC COATINGS, THROUGH 2019 (\$ MILLIONS)</i>	157
Anti-Scratch Coatings	157
<i>TABLE 81 GLOBAL CONSUMPTION OF ALUMINA AND OTHER METAL OXIDE NANOPARTICLES USED IN SCRATCH-RESISTANT COATINGS, THROUGH 2019 (\$ MILLIONS)</i>	158
Low-k Dielectric Films	158
<i>TABLE 82 GLOBAL CONSUMPTION OF NANOSCALE LOW-K DIELECTRIC FILM MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	158

TOPIC	PAGE NO.
Electroconductive Coatings	159
<i>TABLE 83 GLOBAL CONSUMPTION OF NANOSCALE MATERIALS FOR ELECTROCONDUCTIVE COATINGS, THROUGH 2019 (\$ MILLIONS)</i>	159
Thermal Spray Coatings	159
<i>TABLE 84 GLOBAL CONSUMPTION OF NANOSCALE THERMAL SPRAY COATING MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	160
Photovoltaics	160
<i>TABLE 85 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN PHOTOVOLTAICS, THROUGH 2019 (\$ MILLIONS)</i>	160
High-Strength Nanostructured Steel Coatings	161
<i>TABLE 86 GLOBAL CONSUMPTION OF NANOSTRUCTURED STEEL COATINGS, THROUGH 2019 (\$ MILLIONS)</i>	161
OLED Lighting	161
<i>TABLE 87 GLOBAL CONSUMPTION OF OLED LIGHTING BY TYPE, THROUGH 2019 (\$ MILLIONS)</i>	162
Developmental Nanoscale Thin Film Applications	163
<i>TABLE 88 GLOBAL MARKET FOR COMMERCIALY PROMISING NANOSCALE THIN FILM APPLICATIONS STILL UNDER DEVELOPMENT, THROUGH 2019 (\$ MILLIONS)</i>	163
Transparent Electrodes	163
<i>TABLE 89 GLOBAL CONSUMPTION OF NANOMATERIALS USED IN TRANSPARENT ELECTRODES, THROUGH 2019 (\$ MILLIONS)</i>	163
Nanostructured Magnetic Coatings for Medical Devices	164
Biocompatible Coatings	164
Graphene Ultracapacitors	165
Graphene Thermal Spreaders	165
Nanostructured Monolithics	165
<i>TABLE 90 GLOBAL NANOSTRUCTURED MONOLITHIC MARKET, THROUGH 2019 (\$ MILLIONS)</i>	166
Established Commercial Monolithic Applications	166
<i>TABLE 91 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	166
High-pressure Discharge Lamp Tubes	166
<i>TABLE 92 GLOBAL CONSUMPTION OF ALUMINA IN HIGH-PRESSURE DISCHARGE LAMP TUBES, THROUGH 2019 (\$ MILLIONS)</i>	167
Insulation	167
<i>TABLE 93 GLOBAL CONSUMPTION OF AEROGELS FOR BUILDING INSULATION APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	167
Catalysts	168
<i>TABLE 94 TRENDS IN GLOBAL DEMAND FOR CRACKING CATALYSTS, THROUGH 2019 (\$ MILLIONS)</i>	168
<i>TABLE 95 GLOBAL CONSUMPTION OF ZEOLITE NANOCATALYSTS, THROUGH 2019 (\$ MILLIONS)</i>	168
Fuel Cell Membranes	168
<i>TABLE 96 FUEL CELL SALES BY TECHNOLOGY TYPE, THROUGH 2019 (\$ MILLIONS)</i>	169
<i>TABLE 97 GLOBAL CONSUMPTION OF NANOPOROUS POLYMER FUEL CELL MEMBRANE MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	169
Energy Recovery Ventilators	169
<i>TABLE 98 GLOBAL CONSUMPTION OF NANOSTRUCTURED POLYMER ERV FILTERS, THROUGH 2019 (\$ MILLIONS)</i>	170
Nanostructured Structural Steel	170

TOPIC	PAGE NO.
<i>TABLE 99 GLOBAL CONSUMPTION OF NANOSTRUCTURED STRUCTURAL STEEL, THROUGH 2019 (\$ MILLIONS)</i>	171
Developmental Monolithic Applications	171
<i>TABLE 100 GLOBAL MARKET FOR DEVELOPMENTAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	171
Medical Implants	171
<i>TABLE 101 GLOBAL CONSUMPTION OF TITANIUM AND TITANIUM ALLOYS IN ORTHOPEDIC IMPLANTS, THROUGH 2019 (\$ MILLIONS)</i>	172
<i>TABLE 102 GLOBAL CONSUMPTION OF NANOSTRUCTURED TITANIUM FOR MEDICAL IMPLANT APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	172
Aerocapacitors and Other Electrochemical Devices	172
<i>TABLE 103 GLOBAL MARKET FOR ADVANCED ELECTRONIC AND CAPACITIVE ENERGY STORAGE DEVICES, THROUGH 2019 (\$ MILLIONS)</i>	173
<i>TABLE 104 GLOBAL CONSUMPTION OF CARBON AEROGELS IN ELECTROCHEMICAL DEVICES, THROUGH 2019 (\$ MILLIONS)</i>	173
Water Desalination Membranes	174
<i>TABLE 105 GLOBAL CONSUMPTION OF NANOSTRUCTURED POLYMER WATER DESALINATION MEMBRANE MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	174
Nanocomposites	174
<i>TABLE 106 GLOBAL NANOCOMPOSITES MARKET, THROUGH 2019 (\$ MILLIONS)</i>	174
Established Commercial Nanocomposite Applications	174
<i>TABLE 107 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL NANOCOMPOSITE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	174
Automotive Components	175
<i>FIGURE 5 GLOBAL MARKET SHARE OF NANOCOMPOSITE CONSUMPTION IN AUTOMOTIVE APPLICATIONS, 2013 (%)</i>	175
<i>TABLE 108 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN AUTOMOTIVE COMPONENTS, THROUGH 2019 (\$ MILLIONS)</i>	176
Food Packaging	176
<i>TABLE 109 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN FOOD PACKAGING APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	177
Wire and Cable Sheathing	177
<i>TABLE 110 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN WIRE/CABLE SHEATHING AND OTHER FIRE-RETARDANT APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	177
ESD Applications	177
<i>TABLE 111 GLOBAL CONSUMPTION OF NANOCOMPOSITES FOR ESD APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	178
Electrical and Electronic Devices	178
<i>TABLE 112 GLOBAL CONSUMPTION OF MAGNETIC NANOCOMPOSITES FOR ELECTRICAL AND ELECTRONIC APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	178
Sporting Goods	179
<i>TABLE 113 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN SPORTING GOODS, THROUGH 2019 (\$ MILLIONS)</i>	179
Electronics Protection	179
<i>TABLE 114 GLOBAL CONSUMPTION OF POSS NANOCOMPOSITES USED FOR ELECTRONICS SHIELDING, THROUGH 2019 (\$ MILLIONS)</i>	179
Hydrophobic/Oleophobic Nanocomposites	180
<i>TABLE 115 GLOBAL MARKET FOR HYDROPHOBIC/OLEOPHOBIC NANOCOMPOSITES, THROUGH 2019 (\$ MILLIONS)</i>	180
Water Purification Filter	180

TOPIC	PAGE NO.
<i>TABLE 116 GLOBAL CONSUMPTION OF NANOCOMPOSITE WATER PURIFICATION MEMBRANE MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	180
Developmental Nanocomposite Applications	181
<i>TABLE 117 GLOBAL MARKET FOR DEVELOPMENTAL NANOCOMPOSITE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	181
Fuel Cells	181
<i>TABLE 118 FUEL CELL MEMBRANE CONSUMPTION, 2019 (MILLION SQUARE METERS)</i>	182
<i>TABLE 119 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN FUEL CELL MEMBRANES, THROUGH 2019 (\$ MILLIONS)</i>	182
Tungsten Carbide Tools	182
<i>TABLE 120 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN TUNGSTEN CARBIDE TOOLS, THROUGH 2019 (\$ MILLIONS)</i>	183
Protective Clothing	183
<i>TABLE 121 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN PROTECTIVE CLOTHING, THROUGH 2019 (\$ MILLIONS)</i>	183
Photonic Add/Drop Filters	183
<i>TABLE 122 GLOBAL MARKET FOR PHOTONIC CRYSTAL ADD/DROP FILTERS, THROUGH 2019 (\$ MILLIONS)</i>	184
Optical Switches	184
<i>TABLE 123 GLOBAL CONSUMPTION OF QUANTUM DOTS USED IN OPTICAL SWITCHES AND GATES, THROUGH 2019 (\$ MILLIONS)</i>	184
Optical Amplifiers	185
<i>TABLE 124 GLOBAL CONSUMPTION OF QUANTUM DOT-BASED OPTICAL AMPLIFIERS, THROUGH 2019 (\$ MILLIONS)</i>	185
Orthopedic Implants	185
<i>TABLE 125 GLOBAL CONSUMPTION OF NANOCOMPOSITE BONE SUBSTITUTE MATERIALS, THROUGH 2019 (\$ MILLIONS)</i>	186
Conductive Fiber	186
<i>TABLE 126 GLOBAL CONSUMPTION OF NANOCOMPOSITE CONDUCTIVE FIBER, THROUGH 2019 (\$ MILLIONS)</i>	186
Miscellaneous Structural Applications	186
<i>TABLE 127 GLOBAL MARKET FOR GRAPHENE POLYMER COMPOSITES, THROUGH 2019 (\$ MILLIONS)</i>	186
NANOTOOLS	187
<i>TABLE 128 GLOBAL NANOTOOLS SALES, THROUGH 2019 (\$ MILLIONS)</i>	187
Commercial Applications	187
<i>TABLE 129 GLOBAL MARKET FOR COMMERCIAL NANOTOOL APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	188
Nanomanipulators	188
<i>FIGURE 6 GLOBAL NANOMANIPULATOR SHARE OF SALES, 2013 (%)</i>	188
<i>TABLE 130 GLOBAL MARKET OF NANOMANIPULATORS, THROUGH 2019 (\$ MILLIONS)</i>	189
Near-Field Optics	189
<i>TABLE 131 GLOBAL MARKET OF SCANNING NEAR-FIELD OPTICAL MICROSCOPES, THROUGH 2019 (\$ MILLIONS)</i>	190
Nanomachining Tools	190
<i>TABLE 132 GLOBAL MARKET OF NANOMACHINING TOOLS, THROUGH 2019 (\$ MILLIONS)</i>	190
Advanced Optical Nanolithography Tools	190

TOPIC	PAGE NO.
<i>TABLE 133 GLOBAL MARKET OF ADVANCED OPTICAL NANOLITHOGRAPHY TOOLS, THROUGH 2019 (\$ MILLIONS)</i>	190
Developmental Applications	191
<i>TABLE 134 GLOBAL MARKET FOR DEVELOPMENTAL NANOTOOL APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	191
Extreme Ultraviolet Lithography	191
Maskless Optical Lithography	192
Nanoimprint Lithography	192
NANODEVICES	192
<i>TABLE 135 GLOBAL NANODEVICE SALES, THROUGH 2019 (\$ MILLIONS)</i>	193
Commercial Applications	193
<i>TABLE 136 GLOBAL MARKET FOR COMMERCIAL NANODEVICE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)</i>	193
Nano-HPLC	193
<i>TABLE 137 GLOBAL MARKET OF NANO HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY INSTRUMENTS, THROUGH 2019 (\$ MILLIONS)</i>	194
Nanosensors	194
<i>TABLE 138 GLOBAL NANO-CHEMICAL SENSOR MARKET, THROUGH 2019 (\$ MILLIONS)</i>	194
Microfluidic Drug Production Systems	194
<i>TABLE 139 GLOBAL MARKET OF NANOPARTICULATE DRUG PRODUCTION SYSTEMS, THROUGH 2019 (\$ MILLIONS)</i>	195
Developmental Applications	195
Nanostructured Holographic Memory	195
<i>TABLE 140 GLOBAL NANOSTRUCTURED HOLOGRAPHIC STORAGE MARKET, THROUGH 2019 (\$ MILLIONS)</i>	196
NANOTECHNOLOGY BY END-USER SEGMENT	196
<i>TABLE 141 GLOBAL NANOTECHNOLOGY CONSUMPTION BY END-USER SEGMENT, THROUGH 2019 (\$ MILLIONS)</i>	196
<i>FIGURE 7 GLOBAL NANOTECHNOLOGY END-USER MARKET SHARES, 2013 VERSUS 2019 (%)</i>	196
CHAPTER 6 DEVELOPMENTS THAT COULD INFLUENCE THE NANOTECHNOLOGY MARKET	200
ECONOMIC TRENDS	200
<i>FIGURE 8 ANNUAL GROWTH RATE PERCENT OF WORLD GDP, 2012-2019 (%)</i>	200
ATTITUDE OF VENTURE CAPITALISTS	201
ENVIRONMENTAL/HEALTH/SAFETY AND OTHER IMPACTS OF NANOMATERIALS	202
POLITICAL/LLEGAL/REGULATORY TRENDS	204
GOVERNMENT-FUNDED NANOTECHNOLOGY INITIATIVES	204
LAWS AND REGULATIONS	204
LONG-TERM MARKET PROSPECTS	206
CHAPTER 7 NANOTECHNOLOGY INDUSTRY STRUCTURE	208
NUMBER AND SIZE OF FIRMS	208
SIZE DISTRIBUTION OF FIRMS	208
<i>TABLE 142 SIZE DISTRIBUTION OF NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, 2013 (NO./%)</i>	208
<i>FIGURE 9 SIZE DISTRIBUTION PERCENT OF NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, 2013 (%)</i>	208

TOPIC	PAGE NO.
PRODUCTS	209
<i>TABLE 143 NANOTECH COMPANIES IN BCC RESEARCH SAMPLE BY MAIN NANO PRODUCT LINE, 2013 (NO./%)</i>	209
<i>FIGURE 10 NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, PERCENT BY MAIN NANO PRODUCT LINE, 2013 (%)</i>	209
NATIONALITY	210
<i>FIGURE 11 GEOGRAPHICAL DISTRIBUTION OF NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, 2013 (NUMBER)</i>	210
MARKET SHARES	211
NANOMATERIALS	211
<i>FIGURE 12 NANOMATERIALS MANUFACTURERS MARKET SHARES, 2013 (%)</i>	211
NANOTOOLS	212
<i>FIGURE 13 NANOTOOLS MANUFACTURERS MARKET SHARES, 2013 (%)</i>	212
NANODEVICES	213
<i>FIGURE 14 NANODEVICES MANUFACTURERS MARKET SHARES, 2013 (%)</i>	213
CHAPTER 8 COMPANY PROFILES	215
A123 SYSTEMS LLC	215
ADVANCED PLASMONICS INC.	215
ALMATIS GMBH	215
ALPS ELECTRIC CO. LTD	216
ALTAIR NANOTECHNOLOGIES INC.	216
ANTARIA LTD.	216
APHIOS CORP.	217
ARGONIDE CORP.	217
ASPEN AEROGELS INC.	217
BAIKOWSKI INTERNATIONAL CORP.	218
BANGS LABORATORIES INC.	218
BASF SE	218
BAYER AG	219
BIOPHAN TECHNOLOGIES INC.	220
BYK ADDITIVES INC.	220
CABOT MICROELECTRONICS CORP.	220
CAPSULATION PHARMA AG	221
CATALYTIC MATERIALS LLC	221
CDTI INC.	221
CIMA NANOTECH	222
CLARIANT AG	222
COOPER BUSSMAN LLC	222
DAIS ANALYTIC CORP.	223
DENDRITIC NANOTECHNOLOGIES INC.	223
DE NORA NORTH AMERICA INC.	223
DIONEX CORP.	224
DONALDSON CO. INC.	224
DOW CHEMICAL CO.	224
DOWA METALS & MINING CO. LTD	225
DYNAL BIOTECH ASA	225
E. I. DUPONT DE NEMOURS AND CO.	226

TOPIC	PAGE NO.
EASTMAN KODAK CO.	226
EKA CHEMICALS AB	226
EKSIGENT TECHNOLOGIES LLC	227
ENERDEL INC.	227
ENVIROSYSTEMS INC.	228
ESPIN TECHNOLOGIES INC.	228
EV GROUP	229
EVIDENT TECHNOLOGIES	229
EVONIK DEGUSSA GMBH	229
EXXON MOBIL CORP.	230
FERROTEC CORP.	230
FLAMEL TECHNOLOGIES SA	231
FORGE EUROPA LTD.	231
FOSTER CORP.	231
FRONTIER CARBON CORP.	232
FUJIMI CORP.	232
GENERAL MOTORS CORP.	232
GENERAL NANOTECHNOLOGY INC.	233
G24 POWER LTD.	233
GMA INDUSTRIES INC.	233
HEADWATERS NANOKINETIX INC.	234
HEWLETT-PACKARD	234
HOLMENKOL GMBH	235
HONEYWELL SPECIALTY MATERIALS	235
HYPERION CATALYSIS INTERNATIONAL INC.	235
HYPER-THERM HIGH TEMPERATURE COMPOSITES INC.	236
IBM CORP.	236
INFRAMAT CORP.	237
INMAT LLC	237
INTEGRATED NANO-TECHNOLOGIES LLC	237
INVISAGE TECHNOLOGIES	238
ISHIHARA SANGYO KAISHA LTD	238
JOHNSON MATTHEY PLC	239
KABELWERK EUPEN AG	239
KLEINDIEK NANOTECHNIK	239
KLOCKE NANOTECHNIK	240
LYONDELLBASELL POLYMERS	240
MACH 1 INC.	240
MEDIA AND PROCESS TECHNOLOGY INC.	241
MEMBRANE TECHNOLOGY AND RESEARCH INC.	241
MICROFLUIDICS INTERNATIONAL CORP.	241
MICRO-TECH SCIENTIFIC INC.	241
MITSUBISHI CHEMICAL CORP.	242
MOLECULAR IMPRINTS INC.	242
NANOCARRIER CORP. LTD	243
NANOCOR INC.	243
NANOCRYSTALS TECHNOLOGY LTD	243

TOPIC	PAGE NO.
NANOFILM LTD.	244
NANOGATE AG	244
NANOGRAM CORP.	245
NANOH2O INC.	245
NANOMIX INC.	246
NANONEX	246
NANOPHASE TECHNOLOGIES CORP.	247
NANOPORE INC.	247
NANOSOLAR INC.	248
NANOSPECTRA BIOSCIENCES INC	248
NANOSPHERE INC.	249
NANOSTRUCTURED & AMORPHOUS MATERIALS INC.	250
NANOSYS INC.	250
NANO-TEX LLC	250
NANTERO INC.	250
NEI CORP.	251
NEXTECH MATERIALS LTD	251
NPOINT INC.	252
NTERA INC.	252
NVE CORP.	253
NYACOL NANO TECHNOLOGIES INC.	253
OB Ducat AB	254
ORTHOVITA INC.	254
PHARMASOL GMBH	255
PIONEER SURGICAL TECHNOLOGY	255
POLYSCIENCES INC.	255
PSIVIDA CORP.	256
QD VISION INC.	256
QUANTUMSPHERE INC.	256
RAVE LLC	257
RBC LIFE SCIENCES INC.	257
RHODIA SA	258
RITDISPLAY CORP.	258
ROHM AND HAAS CO.	258
ROSSETER HOLDINGS LTD	258
RTP CO.	259
SABIC INNOVATIVE PLASTICS	259
SACHTLEBEN CHEMIE	259
SELDON TECHNOLOGIES	259
SHENZHEN NANO-TECH PORT CO. LTD	260
SHOWA DENKO K.K.	260
SIM COMPOSITES INC.	260
SKYEPHARMA PLC	261
SOLARONIX SA	261
SOUTHWEST NANOTECHNOLOGIES INC.	262
TAYCA CORP.	262
TOHOKU PIONEER CORP.	262

TOPIC	PAGE NO.
TOTO LTD.	263
TPL INC.	263
UBE INDUSTRIES LTD	264
UNIDYM	264
UNITIKA LTD	264
UNIVERSAL DISPLAY CORP.	265
U.S. NANOCORP INC.	265
WILSON SPORTING GOODS CO.	266
XEROX CORP.	266
XINTEK INC.	267
ZETTACORE	267
ZYVEX INSTRUMENTS LLC	268

LIST OF TABLES

TABLE HEADING	PAGE NO.
SUMMARY TABLE GLOBAL NANOTECHNOLOGY MARKET, THROUGH 2019 (\$ MILLIONS)	9
TABLE 1 MAJOR CATEGORIES OF NANOMATERIALS	16
TABLE 2 ESTABLISHED COMMERCIAL NANOPARTICLE APPLICATIONS, 2014	23
TABLE 3 DEVELOPMENTAL NANOPARTICLE APPLICATIONS, 2014	41
TABLE 4 DEVELOPMENTAL NANOTUBE APPLICATIONS, 2014	48
TABLE 5 ESTABLISHED COMMERCIAL NANOSCALE THIN FILM APPLICATIONS, 2014	58
TABLE 6 DEVELOPMENTAL NANOSCALE THIN FILM APPLICATIONS, 2014	69
TABLE 7 ESTABLISHED COMMERCIAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, 2014	75
TABLE 8 DEVELOPMENTAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, 2014	78
TABLE 9 ESTABLISHED COMMERCIAL NANOCOMPOSITE APPLICATIONS, 2014	83
TABLE 10 DEVELOPMENTAL NANOCOMPOSITE APPLICATIONS, 2014	89
TABLE 11 ESTABLISHED COMMERCIAL NANOTOOL APPLICATIONS, 2014	95
TABLE 12 ITRS TECHNOLOGY NODES, 2013-2019 (MINIMUM LINE WIDTH)	98
TABLE 13 ESTABLISHED COMMERCIAL NANODEVICE APPLICATIONS, 2014	101
TABLE 14 DEVELOPMENTAL NANODEVICE APPLICATIONS, 2014	103
TABLE 15 U.S. NANOTECHNOLOGY PATENTS ISSUED BY TYPE, JANUARY 1, 2005 TO JULY 31, 2014 (NUMBER OF PATENTS/%)	106
TABLE 16 COMPANIES AND INSTITUTIONS GRANTED THE LARGEST NUMBER OF U.S. NANOTECHNOLOGY PATENTS, JANUARY 1, 2005 THROUGH JULY 31, 2014 (NUMBER OF PATENTS)	107
TABLE 17 GLOBAL MARKET FOR NANOTECHNOLOGY PRODUCTS, THROUGH 2019 (\$ MILLIONS)	109
TABLE 18 GLOBAL NANOTECHNOLOGY MARKET BY TYPE OF TECHNOLOGY, THROUGH 2019 (\$ MILLIONS)	110
TABLE 19 GLOBAL NANOMATERIALS SALES BY TYPE, THROUGH 2019 (\$ MILLIONS)	112
TABLE 20 GLOBAL SOLID NANOPARTICLE MARKET BY CURRENT STAGE OF COMMERCIALIZATION, THROUGH 2019 (\$ MILLIONS)	114
TABLE 21 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL SOLID NANOPARTICLE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	115
TABLE 22 GLOBAL CONSUMPTION OF PGM POLYMER NANOPARTICLES USED IN COATINGS AND ADHESIVES, THROUGH 2019 (\$ MILLIONS)	116
TABLE 23 GLOBAL TREND IN SEMICONDUCTOR SALES, THROUGH 2019 (\$ BILLIONS)	117
TABLE 24 GLOBAL CONSUMPTION OF SILICA AND ALUMINA NANOPARTICLES USED IN CMP COMPOUNDS, THROUGH 2019 (\$ MILLIONS)	117
TABLE 25 GLOBAL SUNSCREEN SALES, THROUGH 2019 (\$ BILLIONS)	118
TABLE 26 GLOBAL CONSUMPTION OF TIO2 AND ZNO NANOPARTICLES USED IN SUNSCREENS AND OTHER PERSONAL CARE PRODUCTS, THROUGH 2019 (\$ MILLIONS)	118
TABLE 27 GLOBAL MARKET FOR NANOPARTICLE-BASED SYNTHETIC BONE AND TOOTH ENAMELS, THROUGH 2019 (\$ MILLIONS)	119
TABLE 28 GLOBAL PRODUCTION OF ELECTRONIC DEVICES INCORPORATING FERROFLUIDS, THROUGH 2019 (MILLION UNITS)	120
TABLE 29 GLOBAL MARKET FOR IRON OXIDE NANOPARTICLES USED IN FERROFLUIDS, THROUGH 2019 (\$ MILLIONS)	120
TABLE 30 GLOBAL MARKET FOR NANOPARTICLES USED TO DELIVER DRUGS, THROUGH 2019 (\$ MILLIONS)	121
TABLE 31 GLOBAL MARKET FOR POLYMER NANOPARTICLES USED IN FABRIC TREATMENTS, THROUGH 2019 (\$ MILLIONS)	122

TABLE HEADING	PAGE NO.
TABLE 32 GLOBAL MARKET FOR NANOPARTICLES USED AS BIOMEDICAL MARKERS AND DETECTION AIDS, THROUGH 2019 (\$ MILLIONS)	124
TABLE 33 GLOBAL MARKET FOR DENDRIMERS USED IN TRANSFECTION REAGENTS, THROUGH 2019 (\$ MILLIONS)	125
TABLE 34 GLOBAL MARKET FOR SILVER AND SILICA NANOPARTICLES USED IN DIETARY SUPPLEMENTS, THROUGH 2019 (\$ MILLIONS)	126
TABLE 35 GLOBAL MARKET FOR NANOPARTICULATE ALUMINA USED IN ULTRAFILTRATION APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	126
TABLE 36 GLOBAL MARKET FOR NANOPARTICULATE IRON OXIDE USED IN BIOMAGNETIC SEPARATION APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	127
TABLE 37 GLOBAL MARKET FOR NANOPARTICULATE IRON OXIDE USED IN MRI CONTRAST MEDIA, THROUGH 2019 (\$ MILLIONS)	128
TABLE 38 GLOBAL MARKET FOR OIL NANOSPHERES USED IN SURFACE DISINFECTANTS, THROUGH 2019 (\$ MILLIONS)	128
TABLE 39 GLOBAL MARKET FOR NANOPARTICULATE CERIUM OXIDE USED IN DIESEL FUEL ADDITIVES, THROUGH 2019 (\$ MILLIONS)	129
TABLE 40 GLOBAL MARKET FOR NANOPARTICULATE ALUMINA AND IRON OXIDE FOR FUEL AND EXPLOSIVE ADDITIVES, THROUGH 2019 (\$ MILLIONS)	130
TABLE 41 GLOBAL MARKET FOR QUANTUM DOT LASER DIODES, THROUGH 2019 (\$ MILLIONS)	130
TABLE 42 GLOBAL MARKET FOR NANOPARTICLES USED IN PETROLEUM REFINING, THROUGH 2019 (\$ MILLIONS)	131
TABLE 43 GLOBAL MARKET FOR COAL LIQUEFACTION NANOCATALYSTS, THROUGH 2019 (\$ MILLIONS)	132
TABLE 44 GLOBAL CONSUMPTION OF NANOPARTICLES IN MULTILAYER CERAMIC CAPACITOR APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	132
TABLE 45 GLOBAL CONSUMPTION OF SILVER NANOPARTICLES IN ELECTRONIC PRINTING INKS, THROUGH 2019 (\$ MILLIONS)	133
TABLE 46 GLOBAL CONSUMPTION OF NANOPARTICLES USED IN RECHARGEABLE LITHIUM ION BATTERIES, THROUGH 2019 (\$ MILLIONS)	134
TABLE 47 GLOBAL CONSUMPTION OF APTAMERS FOR PROTEOMICS APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	135
TABLE 48 GLOBAL CONSUMPTION OF NANOPARTICLES IN LED FABRICATION, THROUGH 2019 (\$ MILLIONS)	135
TABLE 49 GLOBAL MARKET FOR COMMERCIALY PROMISING NANOPARTICLE APPLICATIONS STILL UNDER DEVELOPMENT, THROUGH 2019 (\$ MILLIONS)	136
TABLE 50 GLOBAL CONSUMPTION OF APTAMERS FOR MOLECULAR IMAGING APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	137
TABLE 51 GLOBAL CONSUMPTION OF NANOPARTICLES IN FLAT-PANEL DISPLAYS, THROUGH 2019 (\$ MILLIONS)	137
TABLE 52 GLOBAL CONSUMPTION OF QUANTUM DOTS IN DIGITAL IMAGE SENSORS, THROUGH 2019 (\$ MILLIONS)	138
TABLE 53 GLOBAL CONSUMPTION OF ELECTROCHROMIC DISPLAY MATERIALS, THROUGH 2019 (\$ MILLIONS)	139
TABLE 54 GLOBAL CONSUMPTION OF GRAPHENE FOR PRINTED ELECTRONICS APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	139
TABLE 55 GLOBAL CONSUMPTION OF GRAPHENE FOR HIGH-PERFORMANCE INTERCONNECTS, THROUGH 2019 (\$ MILLIONS)	140
TABLE 56 GLOBAL CONSUMPTION OF GRAPHENE FOR THERMAL INTERFACE MATERIALS, THROUGH 2019 (\$ MILLIONS)	140
TABLE 57 GLOBAL MARKET FOR NANOTUBES AND OTHER HOLLOW NANOPARTICLES, THROUGH 2019 (\$ MILLIONS)	141

TABLE HEADING	PAGE NO.
TABLE 58 MARKET FOR ESTABLISHED COMMERCIAL CARBON NANOTUBE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	141
TABLE 59 MARKET FOR COMMERCIALY PROMISING NANOTUBE APPLICATIONS STILL UNDER DEVELOPMENT, THROUGH 2019 (\$ MILLIONS)	142
TABLE 60 GLOBAL CONSUMPTION OF CARBON NANOTUBE MEDICAL X-RAY TUBES, THROUGH 2019 (\$ MILLIONS)	143
TABLE 61 GLOBAL CONSUMPTION OF CARBON NANOTUBE INKS IN PRINTED ELECTRONICS, THROUGH 2019 (\$ MILLIONS)	144
TABLE 62 GLOBAL CONSUMPTION OF CARBON NANOTUBE CONDUCTIVE FIBERS, THROUGH 2019 (\$ MILLIONS)	145
TABLE 63 GLOBAL CONSUMPTION OF CARBON NANOTUBE ELECTRODE MATERIALS USED IN ULTRATHIN BATTERIES AND CAPACITORS, THROUGH 2019 (\$ MILLIONS)	146
TABLE 64 GLOBAL NANOSCALE THIN FILM MARKET, THROUGH 2019 (\$ MILLIONS)	146
TABLE 65 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL NANOSCALE THIN FILM APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	147
TABLE 66 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN CATALYTIC CONVERTERS, THROUGH 2019 (\$ MILLIONS)	148
TABLE 67 GLOBAL FUEL CELL SALES BY TECHNOLOGY TYPE, THROUGH 2019 (\$ MILLIONS)	149
TABLE 68 FUEL CELL CONSUMPTION OF PLATINUM THIN FILM CATALYSTS, THROUGH 2019 (\$ MILLIONS)	149
TABLE 69 CONSUMPTION OF OLED THIN FILM MATERIALS, THROUGH 2019 (\$ MILLIONS/%)	150
TABLE 70 GLOBAL CONSUMPTION OF NANOPOROUS THIN FILM MEMBRANES, THROUGH 2019 (\$ MILLIONS)	151
TABLE 71 GLOBAL EYEGLASS COATING SALES, THROUGH 2019 (\$ MILLIONS)	152
TABLE 72 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN EYEGLASS AND OTHER OPTICAL COATINGS, THROUGH 2019 (\$ MILLIONS)	152
TABLE 73 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN ANTIMICROBIAL DRESSINGS, THROUGH 2019 (\$ MILLIONS)	153
TABLE 74 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN OPTICAL RECORDING MEDIA COATINGS, THROUGH 2019 (\$ MILLIONS)	154
TABLE 75 GLOBAL HARD DISK MEDIA PRODUCTION AND THIN FILM MATERIALS CONSUMPTION, THROUGH 2019	154
TABLE 76 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN HARD DISK MEDIA AND RECORDING HEADS, THROUGH 2019 (\$ MILLIONS)	155
TABLE 77 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN MAGNETIC RECORDING MEDIA, THROUGH 2019 (\$ MILLIONS)	155
TABLE 78 GLOBAL OUTPUT OF FIBER OPTIC CABLE, THROUGH 2019 (MILLION KM)	156
TABLE 79 GLOBAL CONSUMPTION OF SILICA NANOMATERIALS FOR FIBER OPTIC CABLE, THROUGH 2019 (\$ MILLIONS)	156
TABLE 80 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN PHOTOCATALYTIC COATINGS, THROUGH 2019 (\$ MILLIONS)	157
TABLE 81 GLOBAL CONSUMPTION OF ALUMINA AND OTHER METAL OXIDE NANOPARTICLES USED IN SCRATCH-RESISTANT COATINGS, THROUGH 2019 (\$ MILLIONS)	158
TABLE 82 GLOBAL CONSUMPTION OF NANOSCALE LOW-K DIELECTRIC FILM MATERIALS, THROUGH 2019 (\$ MILLIONS)	158
TABLE 83 GLOBAL CONSUMPTION OF NANOSCALE MATERIALS FOR ELECTROCONDUCTIVE COATINGS, THROUGH 2019 (\$ MILLIONS)	159
TABLE 84 GLOBAL CONSUMPTION OF NANOSCALE THERMAL SPRAY COATING MATERIALS, THROUGH 2019 (\$ MILLIONS)	160

TABLE HEADING	PAGE NO.
TABLE 85 GLOBAL CONSUMPTION OF NANOSCALE THIN FILM MATERIALS IN PHOTOVOLTAICS, THROUGH 2019 (\$ MILLIONS)	160
TABLE 86 GLOBAL CONSUMPTION OF NANOSTRUCTURED STEEL COATINGS, THROUGH 2019 (\$ MILLIONS)	161
TABLE 87 GLOBAL CONSUMPTION OF OLED LIGHTING BY TYPE, THROUGH 2019 (\$ MILLIONS)	162
TABLE 88 GLOBAL MARKET FOR COMMERCIALY PROMISING NANOSCALE THIN FILM APPLICATIONS STILL UNDER DEVELOPMENT, THROUGH 2019 (\$ MILLIONS)	163
TABLE 89 GLOBAL CONSUMPTION OF NANOMATERIALS USED IN TRANSPARENT ELECTRODES, THROUGH 2019 (\$ MILLIONS)	163
TABLE 90 GLOBAL NANOSTRUCTURED MONOLITHIC MARKET, THROUGH 2019 (\$ MILLIONS)	166
TABLE 91 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	166
TABLE 92 GLOBAL CONSUMPTION OF ALUMINA IN HIGH-PRESSURE DISCHARGE LAMP TUBES, THROUGH 2019 (\$ MILLIONS)	167
TABLE 93 GLOBAL CONSUMPTION OF AEROGELS FOR BUILDING INSULATION APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	167
TABLE 94 TRENDS IN GLOBAL DEMAND FOR CRACKING CATALYSTS, THROUGH 2019 (\$ MILLIONS)	168
TABLE 95 GLOBAL CONSUMPTION OF ZEOLITE NANOCATALYSTS, THROUGH 2019 (\$ MILLIONS)	168
TABLE 96 FUEL CELL SALES BY TECHNOLOGY TYPE, THROUGH 2019 (\$ MILLIONS)	169
TABLE 97 GLOBAL CONSUMPTION OF NANOPOROUS POLYMER FUEL CELL MEMBRANE MATERIALS, THROUGH 2019 (\$ MILLIONS)	169
TABLE 98 GLOBAL CONSUMPTION OF NANOSTRUCTURED POLYMER ERV FILTERS, THROUGH 2019 (\$ MILLIONS)	170
TABLE 99 GLOBAL CONSUMPTION OF NANOSTRUCTURED STRUCTURAL STEEL, THROUGH 2019 (\$ MILLIONS)	171
TABLE 100 GLOBAL MARKET FOR DEVELOPMENTAL NANOSTRUCTURED MONOLITHIC APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	171
TABLE 101 GLOBAL CONSUMPTION OF TITANIUM AND TITANIUM ALLOYS IN ORTHOPEDIC IMPLANTS, THROUGH 2019 (\$ MILLIONS)	172
TABLE 102 GLOBAL CONSUMPTION OF NANOSTRUCTURED TITANIUM FOR MEDICAL IMPLANT APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	172
TABLE 103 GLOBAL MARKET FOR ADVANCED ELECTRONIC AND CAPACITIVE ENERGY STORAGE DEVICES, THROUGH 2019 (\$ MILLIONS)	173
TABLE 104 GLOBAL CONSUMPTION OF CARBON AEROGELS IN ELECTROCHEMICAL DEVICES, THROUGH 2019 (\$ MILLIONS)	173
TABLE 105 GLOBAL CONSUMPTION OF NANOSTRUCTURED POLYMER WATER DESALINATION MEMBRANE MATERIALS, THROUGH 2019 (\$ MILLIONS)	174
TABLE 106 GLOBAL NANOCOMPOSITES MARKET, THROUGH 2019 (\$ MILLIONS)	174
TABLE 107 GLOBAL MARKET FOR ESTABLISHED COMMERCIAL NANOCOMPOSITE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	174
TABLE 108 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN AUTOMOTIVE COMPONENTS, THROUGH 2019 (\$ MILLIONS)	176
TABLE 109 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN FOOD PACKAGING APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	177
TABLE 110 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN WIRE/CABLE SHEATHING AND OTHER FIRE-RETARDANT APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	177

TABLE HEADING	PAGE NO.
TABLE 111 GLOBAL CONSUMPTION OF NANOCOMPOSITES FOR ESD APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	178
TABLE 112 GLOBAL CONSUMPTION OF MAGNETIC NANOCOMPOSITES FOR ELECTRICAL AND ELECTRONIC APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	178
TABLE 113 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN SPORTING GOODS, THROUGH 2019 (\$ MILLIONS)	179
TABLE 114 GLOBAL CONSUMPTION OF POSS NANOCOMPOSITES USED FOR ELECTRONICS SHIELDING, THROUGH 2019 (\$ MILLIONS)	179
TABLE 115 GLOBAL MARKET FOR HYDROPHOBIC/OLEOPHOBIC NANOCOMPOSITES, THROUGH 2019 (\$ MILLIONS)	180
TABLE 116 GLOBAL CONSUMPTION OF NANOCOMPOSITE WATER PURIFICATION MEMBRANE MATERIALS, THROUGH 2019 (\$ MILLIONS)	180
TABLE 117 GLOBAL MARKET FOR DEVELOPMENTAL NANOCOMPOSITE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	181
TABLE 118 FUEL CELL MEMBRANE CONSUMPTION, 2019 (MILLION SQUARE METERS)	182
TABLE 119 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN FUEL CELL MEMBRANES, THROUGH 2019 (\$ MILLIONS)	182
TABLE 120 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN TUNGSTEN CARBIDE TOOLS, THROUGH 2019 (\$ MILLIONS)	183
TABLE 121 GLOBAL CONSUMPTION OF NANOCOMPOSITES IN PROTECTIVE CLOTHING, THROUGH 2019 (\$ MILLIONS)	183
TABLE 122 GLOBAL MARKET FOR PHOTONIC CRYSTAL ADD/DROP FILTERS, THROUGH 2019 (\$ MILLIONS)	184
TABLE 123 GLOBAL CONSUMPTION OF QUANTUM DOTS USED IN OPTICAL SWITCHES AND GATES, THROUGH 2019 (\$ MILLIONS)	184
TABLE 124 GLOBAL CONSUMPTION OF QUANTUM DOT-BASED OPTICAL AMPLIFIERS, THROUGH 2019 (\$ MILLIONS)	185
TABLE 125 GLOBAL CONSUMPTION OF NANOCOMPOSITE BONE SUBSTITUTE MATERIALS, THROUGH 2019 (\$ MILLIONS)	186
TABLE 126 GLOBAL CONSUMPTION OF NANOCOMPOSITE CONDUCTIVE FIBER, THROUGH 2019 (\$ MILLIONS)	186
TABLE 127 GLOBAL MARKET FOR GRAPHENE POLYMER COMPOSITES, THROUGH 2019 (\$ MILLIONS)	186
TABLE 128 GLOBAL NANOTOOLS SALES, THROUGH 2019 (\$ MILLIONS)	187
TABLE 129 GLOBAL MARKET FOR COMMERCIAL NANOTOOL APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	188
TABLE 130 GLOBAL MARKET OF NANOMANIPULATORS, THROUGH 2019 (\$ MILLIONS)	189
TABLE 131 GLOBAL MARKET OF SCANNING NEAR-FIELD OPTICAL MICROSCOPES, THROUGH 2019 (\$ MILLIONS)	190
TABLE 132 GLOBAL MARKET OF NANOMACHINING TOOLS, THROUGH 2019 (\$ MILLIONS)	190
TABLE 133 GLOBAL MARKET OF ADVANCED OPTICAL NANOLITHOGRAPHY TOOLS, THROUGH 2019 (\$ MILLIONS)	190
TABLE 134 GLOBAL MARKET FOR DEVELOPMENTAL NANOTOOL APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	191
TABLE 135 GLOBAL NANODEVICE SALES, THROUGH 2019 (\$ MILLIONS)	193
TABLE 136 GLOBAL MARKET FOR COMMERCIAL NANODEVICE APPLICATIONS, THROUGH 2019 (\$ MILLIONS)	193
TABLE 137 GLOBAL MARKET OF NANO HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY INSTRUMENTS, THROUGH 2019 (\$ MILLIONS)	194
TABLE 138 GLOBAL NANO-CHEMICAL SENSOR MARKET, THROUGH 2019 (\$ MILLIONS)	194

TABLE HEADING	PAGE NO.
TABLE 139 GLOBAL MARKET OF NANOPARTICULATE DRUG PRODUCTION SYSTEMS, THROUGH 2019 (\$ MILLIONS)	195
TABLE 140 GLOBAL NANOSTRUCTURED HOLOGRAPHIC STORAGE MARKET, THROUGH 2019 (\$ MILLIONS)	196
TABLE 141 GLOBAL NANOTECHNOLOGY CONSUMPTION BY END-USER SEGMENT, THROUGH 2019 (\$ MILLIONS)	196
TABLE 142 SIZE DISTRIBUTION OF NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, 2013 (NO./%)	208
TABLE 143 NANOTECH COMPANIES IN BCC RESEARCH SAMPLE BY MAIN NANO PRODUCT LINE, 2013 (NO./%)	209

LIST OF FIGURES

FIGURE TITLE	PAGE NO.
SUMMARY FIGURE GLOBAL NANOTECHNOLOGY MARKET, 2013-2019 (\$ MILLIONS)	9
FIGURE 1 GLOBAL MARKET FOR NANOTECHNOLOGY PRODUCTS, 2013-2019 (\$ MILLIONS)	110
FIGURE 2 GLOBAL NANOTECHNOLOGY MARKET SHARES BY TYPE OF TECHNOLOGY, 2013 VERSUS 2019 (%)	110
FIGURE 3 GLOBAL NANOMATERIALS MARKET SHARES BY TYPE, 2013 VERSUS 2019 (%)	112
FIGURE 4 NANOPARTICLES USED IN BIOLOGICAL MARKER AND DETECTION AID APPLICATIONS, 2013 (%)	122
FIGURE 5 GLOBAL MARKET SHARE OF NANOCOMPOSITE CONSUMPTION IN AUTOMOTIVE APPLICATIONS, 2013 (%)	175
FIGURE 6 GLOBAL NANOMANIPULATOR SHARE OF SALES, 2013 (%)	188
FIGURE 7 GLOBAL NANOTECHNOLOGY END-USER MARKET SHARES, 2013 VERSUS 2019 (%)	196
FIGURE 8 ANNUAL GROWTH RATE PERCENT OF WORLD GDP, 2012-2019 (%)	200
FIGURE 9 SIZE DISTRIBUTION PERCENT OF NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, 2013 (%)	208
FIGURE 10 NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, PERCENT BY MAIN NANO PRODUCT LINE, 2013 (%)	209
FIGURE 11 GEOGRAPHICAL DISTRIBUTION OF NANOTECH COMPANIES IN BCC RESEARCH SAMPLE, 2013 (NUMBER)	210
FIGURE 12 NANOMATERIALS MANUFACTURERS MARKET SHARES, 2013 (%)	211
FIGURE 13 NANOTOOLS MANUFACTURERS MARKET SHARES, 2013 (%)	212
FIGURE 14 NANODEVICES MANUFACTURERS MARKET SHARES, 2013 (%)	213