

PLS043B – Table of Contents

INTRODUCTION	XXIII
STUDY GOALS AND OBJECTIVES	XXIII
REASONS FOR DOING THE STUDY	XXIII
SCOPE OF THE STUDY	XXIV
METHODOLOGY	XXV
ACRONYMS	XXV
ABOUT THE AUTHOR	XXVI
RELATED BCC REPORTS	XXVII
BCC ONLINE SERVICES	XXVII
DISCLAIMER	XXVII
SUMMARY	XXVIII
SUMMARY TABLE ELECTROACTIVE POLYMER MARKET (MILLION POUNDS/ \$ MILLION)	XXVIII
SUMMARY FIGURE ELECTROACTIVE POLYMER MARKET, 2007-2013 (\$ MILLIONS)	XXIX
ELECTROACTIVE POLYMER OVERVIEW	1
BACKGROUND	1
INHERENTLY CONDUCTIVE POLYMERS	1
INHERENTLY DISSIPATIVE POLYMERS (IDPS)	2
CONDUCTIVE PLASTICS	2
INHERENTLY CONDUCTIVE POLYMERS	3
ADDITIONAL TECHNICAL DETAILS	3
SYNTHESIZING CONJUGATED POLYMERS	3
TECHNIQUES FOR MAKING PLASTICS CONDUCTIVE	4
TABLE 1 HOW TO MAKE PLASTICS CONDUCTIVE	4
CONCEPT OF RESISITIVITIES	4
OVERVIEW	4
TABLE 2 RESISTANCE SPECTRUM FOR METHODS OF MAKING PLASTICS CONDUCTIVE	4
CONCEPTS AND NOMENCLATURE	5
ICP HISTORICAL PERSPECTIVE	6
PRIOR TO 1990	6
POST-1990 PERIOD	7
BY 2000	8
TECHNOLOGIES	8
OVERVIEW	8
PREPARATION OF ICPS	9
ENERGY BAND STRUCTURE	9
CHAIN STRUCTURE	10
COMPARISON OF CONDUCTIVITIES OF ICPS WITH METALS, SEMICONDUCTORS, AND INSULATORS	11
TABLE 3 CONDUCTIVITIES OF DOPED ICPS COMPARED WITH METALS, SEMICONDUCTORS, AND INSULATORS	11
DOPING	11

Overview	11
Chemical and Electrochemical Methods	12
Reversal of Doping Process	12
Types of Dopants	13
Goal of Narrow Band Gaps	13
Effect on Color and Optical Properties	13
TABLE 4 COLOR OF DOPED AND UNDOPED CONDUCTIVE POLYMERS	14
IMPORTANCE OF MOLECULAR WEIGHT AND DISTRIBUTION IN CONDUCTIVE POLYMERS	14
IMPROVING HIGH TEMPERATURE CONDUCTIVITY AND TEMPERATURE STABILITY	15
ALLOYING AND BLENDING CONDUCTIVE POLYMERS WITH CONVENTIONAL RESINS	15
RECENT DEVELOPMENTS	15
PERFORMANCE ENHANCEMENTS SOUGHT THROUGH ICPS	16
Conductivity	16
Electrochromic Effects	16
Electroluminescence	16
Photoconductivity	17
Thermochromic Effects	17
PROCESSING CONDUCTIVE POLYMERS	17
Background	17
Problems and Challenges	18
Processing Options for ICPS	18
TABLE 5 ICP PROCESSING TECHNIQUES	18
TABLE 6 STABILITY AND PROCESSING ATTRIBUTES OF KEY ICPS	19
CONDUCTIVE POLYMER TYPES	19
OVERVIEW	19
POLYTHIOPHENES	19
Nature of the Material	19
Poly(3-alkylthiophene)	20
Suppliers	21
H.C. Starck	21
American Dye Source	21
Plextronics, Inc.	21
Other Polythiophene Derivatives	21
PEDOT	21
PEDOT/PSS Complex	22
EDOT	22
Potential Applications	22
Actual Usage of Polythiophenes and Derivatives	22
TABLE 7 BRIEF SUMMARY OF KEY APPLICATIONS OF POLYTHIOPHENE VARIANTS	23
Recent Developments	23
Printed Organic Electronics	23
A New Polythiophene	23

Further Developments with PEDOT	23
BASF to Market Organic Semiconductors Based on Polythiophenes	24
POLYANILINES	24
Overview	24
Nature of the Material	24
Processing	25
FIGURE 1 THE FOUR OXIDATION STATES OF POLYANILINE	26
Characteristics and Properties	26
Overview	26
Can Be Blended with Commodity Polymers and Elastomers	26
Optical Properties	27
Can Be Melt and Solution Processed	27
Potential Applications	27
Suppliers	28
New Developments	29
A New Polyaniline Synthesis	29
New Polyaniline Flexible Materials Conducting Electricity	29
POLYPYRROLES	29
Nature of the Material	29
Processing	30
Potential Applications	31
New Developments	31
Polypyrrole Stability and Coatings for Radar Absorbing Materials	31
POLYACETYLENES	32
Background	32
Preparation	32
Processing	32
Problem of Environmental Instability	33
Potential Applications	33
OTHER INHERENTLY CONDUCTIVE POLYMERS	33
Polyphenylene Vinylene (PPV)	33
Background	33
Processing	34
Potential in Light Emitting Polymers	34
Other Potential Applications	34
Polyfluorenes	34
Polyphenylene Sulfide	35
Phthalocyanines	36
RECENT DEVELOPMENTS	36
Dissolving Conductive Polymers	36
INHERENTLY DISSIPATIVE POLYMERS (IDPS)	36
Overview	36
Technological Aspects and Problems	37
Suppliers	37
ICP COMPETITIVE RESIN SYSTEMS □ CONDUCTIVE PLASTICS	38
BACKGROUND	38

OVERVIEW	38	
TECHNIQUES FOR MAKING PLASTICS CONDUCTIVE		38
TABLE 8 HOW TO MAKE PLASTICS	38	
CONCEPT OF RESISITIVITIES	39	
TABLE 9 RESISTANCE SPECTRUM FOR METHODS OF MAKING PLASTICS		
CONDUCTIVE	39	
TYPES OF CONDUCTIVE PLASTIC MATERIALS		40
CONDUCTIVE PLASTIC ADDITIVES	41	
OVERVIEW	41	
ESD/EMI COMPOUNDS	41	
ANTISTATIC ADDITIVES	41	
METAL FIBERS	42	
Overview	42	
Stainless Steel Fibers	42	
Other Metal Fibers	42	
Carbon Fibers	43	
Carbon Blacks	43	
TECHNICAL ISSUES	43	
COSTS	44	
RESINS USED	44	
NEW DEVELOPMENTS	45	
CARBON NANOTUBES	45	
Overview	45	
Company Activities	45	
CONDUCTIVE FILLER SUPPLIERS	46	
TABLE 10 CONDUCTIVE FILLER SUPPLIERS	46	
RECENT DEVELOPMENTS IN CONDUCTIVE PLASTICS		47
COLORED CONDUCTIVE POLYACETALS	47	
NEW CONDUCTIVE GRADES MEET ECC'S STRICT REGULATIONS		47
CONDUCTIVE POLYMER BLENDS USED IN POWDER COATINGS	47	
CONDUCTIVE TPES	47	
NOVEL CONDUCTIVE ADDITIVES	48	
OTHER CONDUCTIVE PLASTIC SYSTEMS	48	
CONDUCTIVE PAINTS AND COATINGS	48	
Background	48	
Overview	48	
Performance of Alternate Conductive Coatings		49
Background	49	
Copper	49	
Silver	49	
Nickel	49	
COATED PLASTICS FOR ESD CONTROL		49
Comparisons	50	
Other Aspects	50	
Conductive Coating Cost Comparisons		50
CONDUCTIVE FILMS	51	

CONDUCTIVE ELASTOMERS	51
COMPOUNDING CONDUCTIVE PLASTICS	52
KEY SUPPLIERS AND EXAMPLES OF THEIR CONDUCTIVE PLASTIC PRODUCTS	52
BOEDEKER PLASTICS	53
CABOT	53
CIBA SPECIALTY CHEMICALS	53
EASTMAN CHEMICAL	53
LNP ENGINEERING	54
LUBRIZOL ADVANCED MATERIALS	54
POLYONE	55
RTP	55
NEW PRODUCTS	56
EEONNOYX	56
LUBRIZOL	56
PREMIX THERMOPLASTICS	57
MARKET ESTIMATES AND FORECASTS	58
INHERENTLY CONDUCTIVE POLYMERS	58
BACKGROUND	58
OVERALL MARKET BY VOLUME	58
TABLE 11 ICP MARKET BY TYPE OF RESIN BY VOLUME, THROUGH 2013 (THOUSAND POUNDS)	58
TABLE 11 (CONTINUED)	59
PRICING	59
OVERALL ICP MARKET BY VALUE	60
TABLE 12 ICP MARKET BY TYPE OF RESIN BY VALUE, 2007-2013 (\$ MILLIONS)	60
ICP MARKET ESTIMATES BY APPLICATION	61
Overview	61
Polythiophenes	61
TABLE 13 POLYTHIOPHENE MARKET BY APPLICATION, THROUGH 2013 (THOUSAND POUNDS)	61
Polyanilines	62
TABLE 14 POLYANILINE MARKET BY APPLICATION, THROUGH 2013 (THOUSAND POUNDS)	62
Polypyrroles	63
TABLE 15 POLYPYRROLE MARKET BY APPLICATION, THROUGH 2013 (THOUSAND POUNDS)	63
Other ICPs	63
TABLE 16 OTHER ICP MARKET BY APPLICATION, THROUGH 2013 (THOUSAND POUNDS)	64
CONDUCTIVE PLASTICS	64
TABLE 17 CONDUCTIVE PLASTIC MARKET VOLUME BY RESIN, THROUGH 2013 (MILLION POUNDS)	64
TABLE 18 CONDUCTIVE PLASTIC MARKET VALUE BY RESIN, 2007-2013 (\$ MILLIONS)	65

FIGURE 2 CONDUCTIVE PLASTIC MARKET VALUE BY RESIN, 2007-2013 (\$ MILLIONS)	66
OVERALL MARKET SUMMARY	66
TABLE 19 TOTAL ELECTROACTIVE POLYMER MARKET, THROUGH 2013 (THOUSAND POUNDS)	66
TABLE 19 (CONTINUED)	67
TABLE 20 TOTAL ELECTROACTIVE POLYMER MARKET, THROUGH 2013 (\$ THOUSANDS)	67
APPLICATIONS OF ICPS AND CONDUCTIVE PLASTICS	68
BACKGROUND	68
POTENTIAL/CURRENT APPLICATIONS OF ICPS	69
OVERVIEW	69
TABLE 21 POTENTIAL ICP APPLICATIONS BY	69
REVIEW OF POTENTIALLY SIGNIFICANT COMMERCIAL USES OF ICPS	70
SPECIFIC INDIVIDUAL ICP PROPOSED APPLICATIONS	71
APPLICATIONS OF CONDUCTIVE PLASTICS	71
APPLICATIONS OF IDPS	72
OVERVIEW OF COMPETITIVE SCENARIO BETWEEN ICPS AND CONDUCTIVE PLASTICS	72
TABLE 22 COMPETITIVE SCENARIO BETWEEN ICPS AND TRADITIONAL CONDUCTIVELY-FILLED THERMOPLASTICS	72
ELECTRICAL/ELECTRONIC APPLICATIONS	72
OVERVIEW	72
THE STATE OF THE CONSUMER ELECTRONICS INDUSTRY	73
LIGHT-EMITTING DIODES	73
Background	73
Organic Light-Emitting Diodes	74
Overview	74
Some Definitions	74
Historical Background	75
How OLEDs Work	75
Parts of OLEDs	76
Additional Technical Details	76
OLED Technology Summary	77
Advantages of OLEDs	78
Features and Benefits of OLEDs	79
Disadvantages of OLEDs	79
Issue of Shorter Lifetimes than Inorganic LEDs	79
High Prices and Water Issue	80
Other OLED Research Focus	80
Roll-to-Roll Manufacturing	80
Organic Photovoltaics	80
Early Applications	80
Overview	80
Automotive Lighting	81
Signs	81

Other	81
Potential Market Size	82
Early Use of ICPs in OLEDs	83
Recent Developments	84
Overview	84
DuPont Develops New AMOLED Materials and OLED Displays	84
Novald Achieves Very High Lifetimes for White OLEDs	84
Idemitsu Kosan and Universal Display	85
Seiko Epson Advances	85
CAPACITORS	85
Overview	85
Background	86
Capacitor Coating Technology	86
Conductive Polymers in Use	86
Companies Involved	87
Advantages	88
Potential Markets	88
New Developments	88
Polymer Ultracapacitors	88
Kemet Develops New Conductive Polymer Capacitors	89
Crosslink Polymer USA Develops News Conductive Polymer Coatings For Capacitors	89
BATTERIES	89
Background	89
Lithium Batteries	90
Overview	90
Technology	90
Advantages and Disadvantages	90
Advantages	91
Disadvantages	91
Concept of All-Polymer Battery	91
Button Batteries	91
Automotive Batteries	92
Portable Computer Batteries	92
Use in Batteries	93
SEMICONDUCTOR TRANSISTORS	94
Background	94
Moore's Law	94
Silicon Technology	94
Position of Silicon Substrates	95
Silicon-Free Integrated Circuits	95
Concept of Plastic Electronics	95
Concept of Plastic Electronics (Continued)	96
Polymers Used for Plastic/Organic Transistors	97
Processes and Applications	97
Companies Involved	98

Xerox Corporation	98
H.C. Starck	98
Merck KGaA	98
Plextronics	98
Flexible Electronics □ A Potential Promising Outlet	99
Overview	99
Background	99
Potential Applications	99
Rollable Displays	99
Tags/Labels	100
Company Activities	100
DuPont-Bell Labs	100
Philip's Polymer Vision	100
Cambridge Display Technologies and Plastic Logic	100
Other Potential Commercial Uses of Organic Semiconductors	101
Other Recent Developments in Organic Semiconductors	101
Infineon Technologies	101
More Stable Plastic Semiconductors	101
Semiconductive Inks Move Plastic Transistors Closer to Commercialization	102
A Plastic Electronics Material Advance	102
Electrochromic Polymer Films	102
Recent Conductive Polymer Electronic Industry Developments	103
Polyaniline Field Effect Transistors (FETs)	103
Combining ICPs with Flexible Thermoplastics	103
Plastic Logic Moves into Flexible Displays	103
SENSORS	103
Overview	103
Background	104
Remotely Readable Indicators	104
Gas Sensors	105
Odor Sensors	105
Chemical Sensors	105
Biosensors	105
Use of Microelectrodes	106
Recent Developments	107
Use of Sulfonated Aromatics	107
Abtech Scientific	107
Polymer Membrane Sensor Arrays	108
Polyaniline-Based Optical Ammonia Detector	108
Conductive Polymer-Based Sensors	108
ICP-Modified Polyurethane Smart Foams for Pressure Sensing	108
SOLAR CELLS	109
Background	109
Overview	109
Applications	110
Recent Developments	110

Military Applications	110
Thin Film Organic Photovoltaic Technology	110
ELECTRONIC DISPLAYS	111
Background	111
TABLE 23 GLOBAL TV ELECTRONIC DISPLAY SCREENS, THROUGH 2012 (\$ BILLIONS)	111
Cathode Ray Tubes are Still Around	111
Flat Panel Displays	112
Overview	112
Liquid Crystal Flat Panel Displays	112
Overview	112
Background	113
Materials and Technology	113
Costs	114
Possibility of Future Overcapacity	114
Other Flat Panel Display Types	115
Plasma Displays	115
Digital Light Processing (DLPs)	115
Field Emission Displays (FEDs)	115
Liquid Crystal on Silicon (LCOS)	115
Surface-Conduction Electron Emitter Displays (SEDs)	116
Nano-Emissive Displays	116
Conductive Polymer Flat Panel Displays	116
ELECTROMAGNETIC INTERFERENCE (EMI)	116
BACKGROUND	116
OVERVIEW OF EMI SHIELDING	117
MECHANISMS OF SHIELDING	117
EMI EFFECTS	118
THE IMPORTANCE OF SHIELDING	118
CONTROLLING EMI	118
USE OF CONDUCTIVE PLASTICS	119
Background	119
Functions	120
Conductive Additive Selection	120
TABLE 24 SURFACE RESISTIVITY FOR ELECTRONIC DEVICE SUBSTRATES (OHMS/SQ)	121
Conductivity Tests	121
Advantages and Disadvantages of Conductive Plastics	121
Advantages and Disadvantages ... (Continued)	122
USE OF INHERENTLY CONDUCTIVE POLYMERS	123
ROLE OF IDPS	123
ELECTROSTATIC DISCHARGE (ESD)	124
TECHNOLOGY BACKGROUND	124
USE OF METAL CABINETS	124
DEVICE FAILURES DUE TO ESD DAMAGE	125
HOW MUCH STATIC PROTECTION IS NEEDED?	125

SUMMING UP THE ESD SCENARIO	125
ESD IN THE ELECTRONICS INDUSTRY	126
ESD CONTROLS	126
Background	126
Materials and Methods	127
Use of Chemical Additives	127
Background	127
Technology	128
Use of Conductive Fillers	128
Use of Coated Sheets	129
Role of Plastics in ESD Control	129
Static-Dissipative Polymers	130
ICP POTENTIAL	131
Overview	131
Thermoplastic ICP Compounds	131
Antistatic Coatings Used for Polymer Films	132
NEW DEVELOPMENTS	132
Permanent Antistats	132
Carbon Nanotubes for Static Dissipation	132
More Automotive Products for ESD Protection	133
New Conductive Additives Provide Higher ESD Control	133
REPRESENTATIVE COMPANY ESD PRODUCTS	133
TABLE 25 SELECTED KEY ESD PLASTIC PRODUCTS	133
RECENT ESD ACTIVITIES WITHIN THE ELECTRONIC INDUSTRY	134
Background	134
Protecting Printed Circuit Boards (PCBs) From ESD	134
ANTISTATIC PACKAGING	134
Background	134
Topical Coatings	135
Permanently Static-Dissipative Polymers	135
Types of Products and Additives Used	135
Carbon Black	135
Powdered Metals	136
Mixed-Metal Oxides	136
Polymer Alloys	136
Permanent Coatings	136
Other Characteristics of Materials Used in Antistatic Packaging	137
TABLE 26 GENERAL PERFORMANCE CHARACTERISTICS OF SOME COMMERCIALY AVAILABLE ANTISTATIC	138
Examples of Antistatic Packaging Types of Products	138
New Products for Static Dissipation	138
ELECTROSTATIC PAINTABLE PLASTICS	139
Background	139
Overview	139
Applications	140
Automotive Industry Aspects	140

Concept of Compliance Coatings	141
UV-Cured Coatings	142
Molded-in-Color Automotive Exteriors	142
Dry Paint	143
Background	143
Technology	143
New Electrostatically Paintable Plastic Products	143
Bayer	143
Rhodia	143
ANTI-CORROSION PRODUCTS	144
OVERVIEW	144
CORROSION-RESISTANT COATINGS	144
POTENTIAL ROLE OF ICPS	145
ADVANTAGES OF ICP-BASED ANTICORROSION COATINGS	146
COMMERCIAL POLYANILINES FOR CORROSION CONTROL	146
APPLICATIONS OF ICP-BASED ANTICORROSION COATINGS	146
RECENT DEVELOPMENTS	147
Polypyrrole/Aluminum Flake Hybrids as Corrosion Inhibitors	147
TEXTILES/FABRICS (ELECTROTEXTILES)	147
OVERVIEW	147
BACKGROUND	147
MATERIALS USED TO CREATE CONDUCTIVE FIBERS	148
FIBERS THAT CAN BE USED TO MAKE CONDUCTIVE FABRICS	148
TABLE 27 TYPES OF FIBERS THAT CAN BE USED IN CONDUCTIVE FABRICS	149
EXAMPLES OF COMPANIES INVOLVED IN CONDUCTIVE TEXTILES	149
NEW MATERIALS	149
APPLICATIONS	150
NEW DEVELOPMENTS	150
MEMBRANES	150
BACKGROUND	150
POTENTIAL OF ICPS	151
SMART MEMBRANES	151
AVIATION/AEROSPACE	152
OVERVIEW	152
SMART SKIN/STEALTH TECHNOLOGY	152
CONDUCTIVE POLYMERS FOR SPACE SUITS	153
COATINGS/INKS	153
OVERVIEW	153
PROCESSING METHODS	153
SELECTED PRODUCTS	153
Polyanilines	153
Polythiophenes	154
A New Development	154
FUEL CELLS	154
OVERVIEW	154

BACKGROUND	155
CHALLENGES	155
FUEL CELL TYPES	155
NANO-RELATED APPLICATIONS	155
RECENT CONDUCTIVE POLYMER DEVELOPMENTS	156
NANOWIRES	156
CARBON NANOTUBES AND POLYANILINE BLENDS	156
POLYANILINE NANOFIBER SUPPORTED PLATINUM ELECTROCATALYSTS	156
RFID TAGS/LABELS	157
BACKGROUND	157
APPLICATIONS	157
HOW RFIDS FUNCTION	157
OTHER TECHNICAL ASPECTS	158
ROLE OF ELECTROACTIVE POLYMERS	158
MISCELLANEOUS APPLICATIONS	159
OVERVIEW	159
PLASTIC LASERS	159
MICROTOOLS	160
PRINTING PLATES	160
BIOLOGICAL DEVICES	160
SMART/ELECTROCHROMIC WINDOWS	161
PHARMACEUTICALS	161
CAMOUFLAGE COATINGS	162
SOLDERS	162
ELECTROLUMINESCENT LAMPS (EL LAMPS)	162
MEDICAL	162
Biocompatible Conducting Polymers in Medical Applications	162
MARKET ESTIMATES AND FORECASTS BY APPLICATION	163
OVERVIEW	163
TABLE 28 ELECTROACTIVE POLYMER MARKET BY APPLICATION, THROUGH 2013	163
TABLE 28 (CONTINUED)	164
ICP MARKETS BY APPLICATION	164
Overview	164
TABLE 29 ICP MARKET BY APPLICATION, THROUGH 2013 (THOUSAND POUNDS)	164
Capacitors	165
TABLE 30 CAPACITOR MARKET BY ICP PRODUCT TYPE, THROUGH 2013 (THOUSAND POUNDS)	165
ESD/Antistatic Packaging	165
TABLE 31 ESD/ANTISTATIC PACKAGING MARKET BY ICP PRODUCT TYPE, THROUGH 2013 (THOUSAND POUNDS)	165
FIGURE 3 ESD/ANTISTATIC PACKAGING MARKET BY ICP PRODUCT TYPE, 2007-2013 (THOUSAND POUNDS)	166
Corrosion Protection	167

TABLE 32 CORROSION PROTECTION MARKET BY ICP PRODUCT TYPE, THROUGH 2013 (THOUSAND POUNDS)	167
FIGURE 4 CORROSION PROTECTION MARKET BY ICP PRODUCT TYPE, 2007-2013 (THOUSAND POUNDS)	168
Sensors	168
TABLE 33 SENSOR MARKET BY ICP PRODUCT TYPE, THROUGH 2013 (THOUSAND POUNDS)	168
OLEDs	169
TABLE 34 OLED MARKET BY ICP PRODUCT TYPE, THROUGH 2013 (THOUSAND POUNDS)	169
FIGURE 5 OLED MARKET BY ICP PRODUCT TYPE, 2007-2013 (THOUSAND POUNDS)	169
Solar Cells	170
TABLE 35 SOLAR CELL MARKET BY ICP POLYMER TYPE, THROUGH 2013 (THOUSAND POUNDS)	171
FIGURE 6 SOLAR CELL MARKET BY ICP POLYMER TYPE, THROUGH 2013 (THOUSAND POUNDS)	171
Textiles/Fabrics	172
TABLE 36 TEXTILES/FABRICS MARKET BY ICP PRODUCT TYPE, THROUGH 2013 (THOUSAND POUNDS)	172
FIGURE 7 TEXTILES/FABRICS MARKET BY ICP PRODUCT TYPE, 2007-2013 (THOUSAND POUNDS)	172
Organic Semiconductors	173
TABLE 37 ORGANIC SEMICONDUCTOR MARKET BY POLYMER TYPE, THROUGH 2013 (THOUSAND POUNDS)	173
Batteries	174
TABLE 38 BATTERY MARKET BY ICP PRODUCT TYPE, THROUGH 2013 (THOUSAND POUNDS)	174
Miscellaneous Applications	174
TABLE 39 MISCELLANEOUS APPLICATIONS BY ICP TYPE, THROUGH 2013 (THOUSAND POUNDS)	175
FIGURE 8 MISCELLANEOUS APPLICATIONS BY ICP TYPE, 2007-2013 (THOUSAND POUNDS)	175
CONDUCTIVE PLASTICS MARKETS BY APPLICATION	175
TABLE 40 CONDUCTIVE PLASTICS MARKET BY APPLICATION, THROUGH 2013 (MILLION POUNDS)	176
FIGURE 9 CONDUCTIVE PLASTICS MARKET BY APPLICATION, 2007-2013 (MILLION POUNDS)	176
Miscellaneous Applications (Continued)	176
RECENT CONDUCTIVE POLYMER PATENT ACTIVITY	177
U.S. 6,870,516 (MARCH 22, 2005) – LOW COST ANTENNAS USING CONDUCTIVE PLASTICS – INTEGRAL TECHNOLOGIES, INC. (BELLINGHAM, WA)	177
U.S. 6,942,822 (SEPTEMBER 13, 2005) – PROCESS FOR PREPARATION OF POLYANILINE SALT – IBM CORPORATION (ARMONK, NY)	177

U.S. 6,987,440 (JANUARY 17, 2006) – ELECTRICAL DEVICES CONTAINING CONDUCTIVE POLYMERS – TYCO ELECTRONICS (MIDDLETOWN, PA)	177
U.S. 6,994,805 (FEBRUARY 7, 2006) – POLYTHIOPHENE POLYMER WITH HIGH CHARGE-CARRIER MOBILITIES – INFINEON TECHNOLOGIES (MUNICH, GERMANY)	177
U.S. 7,008,562 (MARCH 7, 2006) – METHOD FOR FORMING POLYTHIOPHENE DISPERSIONS - BAYER AG (LEVERKUSEN, GERMANY)	178
U.S. 7,033,639 (APRIL 25, 2006) – POLYANILINE COATING COMPOSITION – ROHM & HAAS COMPANY (MARLBOROUGH, MA)	178
U.S. 7,033,646 (APRIL 25, 2006) – POLYANILINE BLENDS FOR USE IN HIGH EFFICIENCY POLYMERIC ELECTROLUMINESCENT DEVICES - PARA LTD (SUWON-SI, KOREA)	178
U.S. 7,034,164 (APRIL 25, 2006) – ELECTRICALLY CONDUCTIVE POLYMERS CAPABLE OF BEING GRAFTED BY LIGHT FOR BIOSENSORS - UNIVERSITE JOSEPH FOURIER (GRENOBLE, FRANCE)	178
U.S. 7,081,752 (JULY 25, 2006) – ELECTRICALLY LOADING RADIO FREQUENCY COILS USING CONDUCTIVE POLYMERS – GENERAL ELECTRIC COMPANY (SCHENECTADY, NY)	179
U.S. 7,101,495 (SEPTEMBER 5, 2006) – USE OF SULPHONIC AND PHOSPHORIC ACIDS AS DOPANTS FOR POLYANILINE – COMMISSARIAT A L'ENERGIE ATOMIQUE (PARIS, FRANCE)	179
U.S. 7,132,630 (NOVEMBER 7, 2006) – RESISTIVE HEATING USING POLYANILINE FIBERS – SANTA FE SCIENCE AND TECHNOLOGY LLC (SANTA FE, NM)	179
U.S. 7,175,914 (FEBRUARY 13, 92007) – POLYANILINE-CONTAINING FILM SURFACES – DENSO CORPORATION (KARIYA, JAPAN)	179
U.S. 7,217,295 (MAY 15, 2007) – USE OF SOLUBLE CONDUCTIVE POLYMERS FOR TREATING HUMAN KERATIN FIBERS - L.OREAL S.A. (PARIS, FRANCE)	180
U.S. 7,250,461 (JULY 31, 2007) – CONDUCTIVE POLYMER ORGANIC FORMULATIONS WITH POLYMERIC COLLOIDS FOR ELECTRONIC APPLCATIONS – DUPONT (WILMINGTON, DE)	180
U.S. 7,288,218 (OCTOBER 30, 2007) – DEAGGREGATED ELECTRICALLY CONDUCTIVE POLYMERS – IBM CORPORATION (ARMONK, NY)	180
INDUSTRY STRUCTURE	181
OVERVIEW	181
COMPANIES INVOLVED	181
SELECTED DETAILS ON VARIOUS MAJOR PLAYERS	182
SEGMENTATION OF MAJOR PLAYERS INTO BUSINESS CATEGORIES	183
TABLE 41 SEGMENTATION OF MAJOR PLAYERS INTO BUSINESS CATEGORIES	183
SELECTED ELECTROACTIVE POLYMER PRODUCT LINES	183
TABLE 42 SELECTED ELECTROACTIVE POLYMER PRODUCT LINES	184
SELECTED ELECTROACTIVE POLYMER ... (CONTINUED)	185
COMPANY PROFILES	186
ABTECH SCIENTIFIC, INC.	186

AGFA-GEVAERT GROUP NV	186
AIR PRODUCTS & CHEMICALS	187
AMERICAN DYE SOURCE, INC.	187
BASF, INC.	188
CAMBRIDGE DISPLAY TECHNOLOGY	189
CENTRAL CORPORATION	190
CROSSLINK POLYMER RESEARCH	190
DUPONT DISPLAYS	191
EEONYX	192
FRACTAL SYSTEM, INC.	193
KEMET CAPACITORS	193
KLOCKNER PENTAPLAST OF AMERICA	194
LNP ENGINEERING PLASTICS	194
LUBRIZOL ADVANCED MATERIALS	195
MARKTEK, INC.	195
MERCK KGAA – DARMSTADT, GERMANY	196
MILLIKEN RESEARCH CORPORATION	197
NANOGENESYS, INC.	197
ORMECON CHEMIE	198
PANIPOL LTD	198
PLASTIC LOGIC	199
PLEXTRONICS, INC.	200
POLYMER VISION, LTD	201
POLYONE	201
PREMIX OY	202
RIEKE METALS, INC	202
RTP COMPANY	203
H.C. STARCK INTERNATIONAL	204
STERLING FIBERS	205
UNIVERSAL DISPLAY CORPORATION	205