

## TABLE OF CONTENTS

<b>1 EXECUTIVE SUMMARY.....</b>	<b>12</b>
1.1 Market trends .....	12
1.2 Market drivers and trends .....	14
1.3 Global market size and opportunity .....	16
<b>2 INTRODUCTION .....</b>	<b>19</b>
2.1 Aims and objectives of the study .....	19
<b>3 RESEARCH METHODOLOGY.....</b>	<b>19</b>
<b>4 ADVANCED COATINGS &amp; PAINTS MARKET ANALYSIS.....</b>	<b>20</b>
4.1 ADVANCED ABRASION & WEAR-RESISTANT COATINGS.....	20
4.1.1 Types of advanced abrasion and wear-resistant coatings .....	20
4.1.2 Applications.....	22
4.1.3 Global market size .....	23
4.1.4 Companies.....	23
4.2 ADVANCED ANTI-CORROSION COATINGS .....	28
4.2.1 Types of advanced anti-corrosion paints and coatings .....	28
4.2.2 Applications.....	30
4.2.3 Global market size .....	32
4.2.4 Companies.....	33
4.3 ADVANCED ANTI-FINGERPRINT COATINGS .....	37
4.3.1 Types of advanced anti-fingerprint coatings.....	37
4.3.2 Applications.....	39
4.3.3 Global market size .....	40
4.3.4 Companies.....	41
4.4 ADVANCED ANTI-ICING AND DE-ICING.....	44
4.4.1 Types of advanced anti-icing and de-icing coatings.....	44
4.4.2 Applications.....	46
4.4.3 Global market size .....	47
4.4.4 Companies.....	48
4.5 ADVANCED ANTI-MICROBIAL COATINGS & PAINTS .....	50

4.5.1	Types of advanced anti-microbial coatings and paints.....	50
4.5.2	Applications.....	53
4.5.3	Global market size .....	54
4.5.4	Companies.....	55
4.6	ADVANCED ANTI-REFLECTIVE COATINGS .....	58
4.6.1	Types of advanced anti-reflective coatings .....	58
4.6.2	Applications.....	60
4.6.3	Global market size .....	61
4.6.4	Companies.....	62
4.7	ADVANCED BARRIER COATINGS .....	64
4.7.1	Types of advanced barrier coatings.....	64
4.7.2	Applications.....	65
4.7.3	Global market size .....	66
4.7.4	Companies.....	67
4.8	ADVANCED ELECTROCHROMIC COATINGS.....	69
4.8.1	Types of electrochromic coatings .....	70
4.8.1.1	Inorganic metal oxides.....	71
4.8.1.2	Organic EC materials.....	71
4.8.1.3	Nanomaterials.....	71
4.8.2	Applications.....	72
4.8.2.1	Residential and commercial windows.....	72
4.8.2.2	Automotive.....	73
4.8.2.3	Aerospace.....	75
4.8.2.4	Sunglasses and visors.....	75
4.8.2.5	Flexible displays and wearables .....	75
4.8.3	Global market size .....	76
4.8.4	Companies.....	77
4.9	ADVANCED THERMOCHROMIC COATINGS .....	78
4.9.1	Types of thermochromic coatings.....	78
4.9.2	Applications.....	80
4.9.3	Global market size .....	80
4.9.4	Companies.....	80

4.10	ADVANCED HYDROPHOBIC, SUPERHYDROPHOBIC AND OLEOPHOBIC COATINGS .....	81
4.10.1	Types of advanced hydrophobic, superhydrophobic and oleophobic coatings.....	81
4.10.1.1	Hydrophobic coatings .....	82
4.10.1.2	Properties .....	82
4.10.1.3	Superhydrophobic.....	83
4.10.2	Applications.....	83
4.10.3	Global market size .....	84
4.10.4	Companies.....	85
4.11	ADVANCED PHOTOCATALYTIC SELF-CLEANING COATINGS .....	93
4.11.1	Types of photocatalytic self-cleaning coatings .....	93
4.11.2	Applications.....	93
4.11.3	Global market size .....	95
4.11.4	Companies.....	95
4.12	ADVANCED SELF-HEALINGS COATINGS.....	100
4.12.1	Types of self-healing coatings .....	100
4.12.1.1	Anti-corrosion.....	100
4.12.1.2	Scratch repair .....	100
4.12.1.3	Extrinsic self-healing.....	102
4.12.1.4	Intrinsic self-healing .....	103
4.12.1.5	Healing volume .....	104
4.12.1.6	POLYURETHANE CLEAR COATS.....	105
4.12.1.7	MICRO-/NANOCAPSULES.....	106
4.12.1.8	MICROVASCULAR NETWORKS .....	107
4.12.1.9	REVERSIBLE POLYMERS .....	107
4.12.1.10	CLICK POLYMERIZATION .....	107
4.12.1.11	POLYAMPHOLYTE HYDROGELS .....	108
4.12.1.12	SHAPE MEMORY .....	108
4.12.2	Applications.....	109
4.12.3	Global market size .....	111
4.12.4	Companies.....	112
4.13	ADVANCED THERMAL BARRIER AND FLAME RETARDANT COATINGS.....	114
4.13.1	Types of advanced thermal barrier and flame-retardant coatings.....	114

4.13.2	Applications.....	115
4.13.3	Global market size .....	116
4.13.4	Companies.....	117
4.14	ADVANCED UV-RESISTANT PAINTS AND COATINGS.....	118
4.14.1	Types of advanced UV-resistant coatings .....	118
4.14.2	Applications.....	119
4.14.3	Global market size .....	120
4.14.4	Companies.....	121
4.15	ADVANCED WATER-BORNE PAINTS AND COATINGS .....	123
4.15.1	Types of advanced water-borne paints and coatings.....	123
4.15.2	Applications.....	124
4.15.3	Global market size .....	124
4.15.4	Companies.....	125
4.16	ADVANCED POWDER COATINGS.....	127
4.16.1	Types of advanced powder coatings .....	127
4.16.2	Applications.....	128
4.16.3	Global market size .....	129
4.16.4	Companies.....	129
4.17	POLY(IONIC LIQUID) COATINGS .....	130
4.17.1	Applications.....	131
4.18	METAL-ORGANIC FRAMEWORK (MOF) COATINGS.....	131
4.18.1	Applications.....	132
4.18.2	Companies.....	133
<b>5</b>	<b>REFERENCES .....</b>	<b>135</b>

## TABLES

<b>Table 1.</b>	Overall market trends in advanced paints and coatings.....	13
<b>Table 2.</b>	Market trends and drivers in advanced and high-performance paints and coatings, by target markets.....	14
<b>Table 3.</b>	Advanced coatings market revenues 2018-2028.....	17

**Table 4.** Types of advanced abrasion and wear-resistant paints and coatings. .... 20

**Table 5.** Advanced abrasion & wear resistant coatings applications. .... 22

Table 6. Global market revenues and outlook for advanced abrasion & wear resistant paints and coatings market. ... 23

**Table 7.** Advanced abrasion & wear resistant paints and coatings companies and products. .... 23

**Table 8.** Types of advanced anti-corrosion paints and coatings. .... 28

**Table 9.** Advanced anti-corrosion coatings markets and applications. .... 31

**Table 10.** Global market revenues and outlook for advanced anti-corrosion paints and coatings market. .... 32

**Table 11.** Advanced anti-corrosion companies and products. .... 33

**Table 12.** Advanced anti-fingerprint coatings markets and applications. .... 39

**Table 13.** Global market revenues and outlook for advanced anti-fingerprint paints and coatings market. .... 40

**Table 14.** Advanced anti-fingerprint coatings companies and products. .... 41

**Table 15.** Types of advanced anti-icing and de-icing coatings. .... 45

**Table 16.** Advanced anti-icing and de-icing coatings markets and applications. .... 46

**Table 17.** Global market revenues and outlook for advanced anti-icing and de-icing paints and coatings market. .... 47

**Table 18.** Advanced anti-icing and de-icing companies and products. .... 48

**Table 19.** Types of advanced anti-microbial coatings and paints. .... 51

**Table 20.** Advanced anti-microbial coatings markets and applications. .... 53

**Table 21.** Global market revenues and outlook for advanced anti-microbial paints and coatings market. .... 54

**Table 22.** Advanced anti-microbial paints and coatings companies and products. .... 55

**Table 23.** Types of advanced anti-reflective coatings. .... 59

**Table 24.** Advanced anti-reflective coatings markets and applications. .... 61

**Table 25.** Global market revenues and outlook for advanced anti-reflective coatings market. .... 61

**Table 26.** Advanced anti-reflective coatings companies and products. .... 62

**Table 27.** Types of advanced barrier coatings. .... 64

**Table 28.** Advanced barrier coatings markets and applications. .... 65

**Table 29.** Global market revenues and outlook for the advanced barrier coatings market. .... 66

**Table 30.** Advanced barrier paints and coatings companies and products. .... 67

**Table 31.** Types of electrochromic materials and applications. .... 70

**Table 32.** Global market revenues and outlook for the electrochromic coatings market. .... 76

**Table 33.** Advanced electrochromic coatings companies and products. .... 77

**Table 34.** Thermochromic smart coatings markets and applications. .... 80

**Table 35.** Global market revenues and outlook for the thermochromic coatings market. .... 80

<b>Table 36.</b> Advanced thermochromic coatings companies and products. ....	80
<b>Table 37.</b> Types of advanced hydrophobic, superhydrophobic and oleophobic coatings. ....	81
<b>Table 38.</b> Contact angles of hydrophilic, super hydrophilic, hydrophobic and superhydrophobic surfaces. ....	82
<b>Table 39.</b> Hydrophobic, superhydrophobic and oleophobic markets and applications. ....	83
<b>Table 40.</b> Global market revenues and outlook for hydrophobic, superhydrophobic and oleophobic coatings. ....	84
<b>Table 41.</b> Advanced hydrophobic and superhydrophobic coatings companies and products. ....	85
<b>Table 42.</b> Applications of photocatalytic self-cleaning coatings. ....	94
<b>Table 43.</b> Global market revenues and outlook for the photocatalytic self-cleaning coatings market. ....	95
<b>Table 44.</b> Advanced photocatalytic self-cleaning coatings companies and products. ....	95
<b>Table 45.</b> Types of self-healing coatings and materials. ....	100
<b>Table 46.</b> Comparative properties of self-healing materials. ....	101
<b>Table 47.</b> Comparison of self-healing systems. ....	104
<b>Table 48.</b> Self-healing materials and coatings markets and applications. ....	110
<b>Table 49.</b> Global market revenues and outlook for advanced self-healing coatings market. ....	111
<b>Table 50.</b> Advanced self-healing companies and products. ....	112
<b>Table 51.</b> Types of advanced thermal barrier and flame-retardant coatings. ....	115
<b>Table 52.</b> Advanced thermal barrier and flame-retardant coatings markets and applications. ....	115
<b>Table 53.</b> Global market revenues and outlook for the advanced thermal barrier and flame-retardant coatings market. ....	116
<b>Table 54.</b> Advanced thermal barrier and flame-retardant coatings companies and products. ....	117
<b>Table 55.</b> Types of advanced UV-resistant paints and coatings. ....	119
<b>Table 56.</b> Advanced UV-resistant paints and coatings markets and applications. ....	119
<b>Table 57.</b> Global market revenues and outlook for the advanced UV-resistant paints and coatings market. ....	120
<b>Table 58.</b> Advanced UV-resistant paints and coatings companies and products. ....	121
<b>Table 59.</b> Types of advanced water-borne paints and coatings. ....	123
<b>Table 60.</b> Advanced water-borne paints and coatings markets and applications. ....	124
<b>Table 61.</b> Global market revenues and outlook for the advanced water-borne paints and coatings market. ....	124
<b>Table 62.</b> Advanced water-borne paints and coatings companies and products. ....	125
<b>Table 63.</b> Types of advanced powder coatings. ....	127
<b>Table 64.</b> Advanced powder coatings markets and applications. ....	128
<b>Table 65.</b> Global market revenues and outlook for the advanced powder coatings market. ....	129
<b>Table 66.</b> Advanced powder coatings companies and products. ....	129
<b>Table 67.</b> Applications of poly (ionic liquid) coatings. ....	131

**Table 68.** Applications of MOF coatings..... 132  
**Table 69.** MOF companies and products. .... 133

## FIGURES

**Figure 1.** Paints and coatings industry by market segmentation 2018. .... 16  
**Figure 2.** Paints and coatings industry by regional segmentation 2018. .... 17  
**Figure 3.** Cold rolled steel panels after 96 hrs of ASTM B117-16 salt fog ..... 31  
**Figure 4.** Schematic of anti-fingerprint nanocoatings..... 38  
**Figure 5.** Toray anti-fingerprint film (left) and an existing lipophilic film (right)..... 38  
**Figure 6.** Types of anti-fingerprint coatings applied to touchscreens. .... 39  
**Figure 7.** NANOMYTE® SuperAi, a Durable Anti-ice Coating..... 44  
**Figure 8.** SLIPS coating schematic. .... 44  
**Figure 9.** Hydrophilic anti-frost coating for air conditioners..... 45  
**Figure 10.** (A) illustrates biocidal nanocoating resistance to bacteria. (B) illustrates biocidal nanocoating resistance to fungus. .... 51  
**Figure 11.** Schematic of silver nanoparticles penetrating bacterial cell membrane..... 51  
**Figure 12.** Anti-microbial film developed using roll-to-roll sputtering. .... 54  
**Figure 13.** Nanotextured glass (top) compared to regular glass (bottom) greatly reduces the glare from lights overhead. .... 59  
**Figure 14.** Demo solar panels coated with nanocoatings. .... 59  
**Figure 15.** Display case coated with AR coating (left)..... 60  
**Figure 16.** Typical setup of an electrochromic device (ECD)..... 70  
**Figure 17.** Electrochromic smart glass schematic..... 70  
**Figure 18.** Electrochromic smart glass..... 72  
**Figure 19.** Examples of electrochromic smart windows each in fully coloured (left) and bleached state (right). .... 73  
**Figure 20.** "Infinity" electrochromic mirror. .... 74  
**Figure 21.** Rear-view electrochromic mirrors, off (left image) and on (right image) state..... 74  
**Figure 22.** Argil electrochromic film laminated between automotive glass for sidelite applications..... 74  
**Figure 23.** Alteos Interactive Window Systems..... 75  
**Figure 24.** Argil electrochromic film integrated with polycarbonate lenses. .... 76

**Figure 25.** Thermo-chromic smart windows schematic. .... 79

**Figure 26.** Vertical insulated glass unit for a Suntuitive® thermo-chromic window..... 79

**Figure 27.** A schematic of (a) water droplet on normal hydrophobic surface with contact angle greater than 90° and (b) water droplet on a superhydrophobic surface with a contact angle > 150° ..... 82

**Figure 28.** Contact angle on superhydrophobic coated surface. .... 83

**Figure 29.** Schematic of self-healing polymers. Capsule based (a), vascular (b), and intrinsic (c) schemes for self-healing materials. Red and blue colours indicate chemical species which react (purple) to heal damage..... 102

**Figure 30.** Stages of self-healing mechanism. .... 102

**Figure 31.** Self-healing mechanism in vascular self-healing systems..... 103

**Figure 32.** Microspheres incorporating self-healing materials. .... 105

**Figure 33.** Flow of self-healing materials into the crack site. .... 105

**Figure 34.** Schematic of the self-healing concept using microcapsules with a healing agent..... 106

**Figure 35.** UV-curable shape memory coating..... 109

**Figure 36.** Flame retardant nanocoating. .... 114

**Figure 37.** Schematic drawing of a metal–organic framework (MOF) structure. .... 132