

# Multifunctional Smart Coatings and Surfaces: 2016-2023

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## Abstracts

n-tech believes that the coming decade will see substantial new business revenues generated by smart coatings that exhibit multiple functionalities. In fact, we are already seeing multifunctional coatings and surfaces reach actual commercialization:

In the construction industry we have now reached the point where it is possible to fabricate smart windows that combine self-dimming, solar energy generation and self-healing into a single IGU

In aerospace, some smart surfaces can monitor the structural health of wings and fuselage and then make modest repairs automatically

In medicine, the development of coatings with antimicrobial and anti-inflammatory properties is of obvious importance. Here a group of researchers has already created a multifunctional coating on bioactive agents, which addresses both these issues together.

The multifunctional coatings opportunity is being shaped by the growing marketplace insistence that buildings, transportation, devices for providing healthcare and even complete cities be “smart.” In some cases multifunctional smart coatings and surfaces may improve functionality, while at the same time improving aesthetics

Coatings and surfaces that are smart in multiple ways would seem to fit better into the evolving need for “smarts” than garden varieties, of smart coatings. n-tech also sees in multifunctional coatings a considerable potential for coatings firms – both large, established firms and start-ups – to create significant market value, while differentiating

themselves in the market.

Optimistic visions of a profitable multifunctional future for the coatings industry should be balanced not only against the need to match functions with market needs, but with the capabilities of materials and fabrication tools.

Some multifunctional coatings are already on the market, but others are not ready for prime time. Much the same can be said of tools, where there is currently a plethora of fabrication approaches to creating multifunctional surfaces – although some of them are not yet capable of covering the large areas required (say) by the walls of a building.

### Objectives of this Report

Identifying how and where value will be created with multifunctional coatings. This report provides a technological roadmap for multifunctional smart coatings and surfaces, showing how they (1) can create value by drastically improving price/performance ratios and (2) establish entirely new smart product capabilities in many industry sectors, especially in automotive, aerospace, healthcare and medicine, and construction. We also examine how the technologies and applications in this sector are likely to evolve over the next ten years.

Assessment of which combinations of functionalities will be most successful in the marketplace. The report also looks at what are the most marketable combinations of functionality for each of the industry sectors discussed. In carrying out this analysis we examine how self-cleaning, self-healing, smart antimicrobial, color shifting, anticorrosion and photovoltaic functionality can be combined in different ways and for different market sectors.

Strategic profiles. This report also contains profiles of leading companies developing multifunctional smart materials. These include leading specialty chemical companies, glass firms and start-ups. We also examine how supply chains are evolving for their products and where important R&D projects seem to be taking us in terms of commercialization,

Ten-year forecasts. In the balance of the report we examine various end-user sectors, where multifunctional smart coatings and surfaces are already being used or will be in the near future. For each of these sectors we present an eight-year market forecast and also show how multifunctional smart products have a market fit with current sector wide trends. Specifically, we show which combinations of smart functionalities will be the

most productive in terms of revenue generation.

Our forecasts of multifunctional coatings comprise detailed projections of volume (in square meters and units) and revenue (in \$ millions), broken down by:

End user sector

Type of functionality and product

Material and technology

## Coverage

In this report, we analyze the market for this emerging class of multifunctional smart coatings and related surfaces. The coverage includes:

**Materials evolution.** This report covers materials based on inorganic, organic and biological materials, as well as man-made materials – composites and metamaterials. It discusses product developments that will enable such materials to serve in a multifunctional market environment. As part of this analysis the report examines existing multifunctional coatings products as well as taking a peek at what is likely to emerge from notable labs in the next decade.

Multifunctionality represents an environment in which coatings may have to transcend conventional coatings technologies. The report looks at both multifunctionality delivered through multi-layered coatings as well as materials that are intrinsically multifunctional. And, although the focus of this report is on the market for coatings, we also discuss the competition between smart multifunctional materials and sensor-embedded surfaces.

Emerging fabrication approaches for multifunctional coatings. Both coatings synthesis and coatings applications are in a state of flux at the present time. The report discusses how fabrication and simulation approaches will better enable multifunctional coatings. Areas covered in this analysis will include novel techniques for coating synthesis, curing, characterization, and multiscale modeling, as well scaling up coating operations so that large surfaces can be better coated with multifunctional coatings. Applications and end-user markets for multifunctional coatings. This report identifies the applications areas where n-tech believes multifunctional coatings and surfaces have a real opportunity to move beyond the lab to high-volume commercial applications. In this

report we discuss those areas where multifunctional coatings are already being used or are under serious consideration – the automotive industry, aerospace, healthcare and medicine, and construction.

We also analyze how multifunctional coatings will also be used in other industries such as textiles, electronics and consumer products. Among the topics considered are how specific coating technologies are being matched to the needs of multifunctional coatings for specific

Strategic profiles of key players. This report evaluates the product/market strategies of the leading suppliers in the multifunctional coatings and surfaces space. Firms that are discussed in this report include:

AGC

AkzoNobel

Alcoa

BASF

BigSky Technologies

Casalgrande

Clariant

Cornerstone Research

Corning

Covestro

Crossville

Diamon-Fusion

Dow Chemical

Dow Corning

DSM Biomedical

DuPont

Essroc/Italcementi

Evonik

Faurecia

Fraunhofer IFM

Gelest

Gentex

GKN

Green Earth Nano Science

Guard

Hanergy

Haruna

Heliatek

Klingshield

Life Material

Luna Innovations

Magna

Microban

MMT Textiles

NanoFlex

NEI

Nano Lab

nanoShell

Nanosonic

Next Energy

Nissan

NSG/Pilkington

PPG

PureTi

Reactive

Reckli

Research Frontiers

Saint-Gobain

Sciessent

Sensor Coating Systems

Schoeller

SLIPS Technologies

Sunpartner

Sto

Toto

Ultratech

Vestagen

Vestex

Viavi

Yanfeng

## Contents

### EXECUTIVE SUMMARY

- E.1 Summary of Opportunities for Multifunctional Smart Materials by End-User Market
  - E.1.1 Construction: Large Addressable Market
  - E.1.2 Automotive: Early User of Multifunctional
  - E.1.3 Aerospace: Small Market/High-Value Added
  - E.1.4 From Multipurpose to Multifunctional
- E.2 Opportunities in Fabricating Multifunctional Smart Surfaces
- E.3 Companies to Watch in the Smart Multifunctional Materials Space
- E.4 Summary of Ten-Year Market Forecasts
  - E.4.1 Summary by End User Sector
  - E.4.2 Summary by Type of Material

### CHAPTER ONE: INTRODUCTION

- 1.1 Background to this Report
  - 1.1.1 The Meaning of Multifunctionality
  - 1.1.2 State of the Multifunctional Art
  - 1.1.3 Multifunctional Surfaces and the Smartness Meme
  - 1.1.4 Multifunctional Surfaces and the War Against Commoditization
  - 1.1.5 Fabrication of Multifunctional Surfaces: Opportunities and Implications
- 1.2 Objectives and Scope of this Report
  - 1.2.1 Goals of the Report
  - 1.2.2 The Scope and Definition of Multifunctionality
- 1.3 Methodology and Sources of Information
  - 1.3.1 Forecasting Methodology
- 1.4 Plan of this Report

### CHAPTER TWO: MULTIFUNCTIONAL SMART MATERIALS TECHNOLOGY: OPPORTUNITIES AND EVOLUTION

- 2.1 Multifunctional Materials as Smart Materials
  - 2.1.1 Multifunctionals as the Most Functional of Functional Materials
  - 2.1.2 Multifunctionals as the End Game for Smart Materials
  - 2.1.3 Multifunctionals and the Evolution towards Programmable Matter
  - 2.1.4 A Multifunctionality Roadmap for Smart Materials
- 2.2 Smart Materials for Smart Surfaces: The Multifunctionality Factor



- 2.2.1 Self-Healing Materials
- 2.2.2 Self-Cleaning Materials
- 2.3 Relationship of Smart Surfaces to Smart Coatings
- 2.4 Sensors, Surfaces and Multifunctionality
  - 2.4.1 Evolution of Low-Cost Sensors and the Cost Factor
  - 2.4.2 Types of Sensors for Surfaces
- 2.5 Manufacturing Innovations
  - 2.5.1 Optical Lithography
  - 2.5.2 Functional Printing
  - 2.5.3 Nanomanufacturing Processes
  - 2.5.4 Layer-by-Layer Self-Assembly
- 2.6 Key Points from this Chapter

## **CHAPTER THREE: MULTIFUNCTIONAL SMART MATERIALS IN THE CONSTRUCTION INDUSTRY**

- 3.1 Multifunctional Building Surfaces: Economic Factors and Addressable Market Issues
  - 3.1.1 Future Construction Markets: Impact on Multifunctional Materials
  - 3.1.2 Multifunctional Materials and Decline of “Greentech”
- 3.2 Commercially Attractive Combinations of Functionalities
- 3.3 Smart Glass as a Platform for Multifunctional Windows?
  - 3.3.1 How Multifunctional Smart Materials take Smart Windows to the Next Stage
  - 3.3.2 Four Marketing Strategies for Multifunctional Glass
- 3.4 Multifunctional Smart Materials for Roofs, Walls and Roads
  - 3.4.1 Interior Walls and Surfaces: Antimicrobials Meet Self-Cleaning
  - 3.4.2 Concrete and Cement: Beyond Self-Healing and Self-Cleaning
  - 3.4.3 Exterior Surfaces: New Opportunities from the Rise of Monolithically Integrated BIPV
- 3.5 Multifunctional Paints, Coatings and Laminates
  - 3.5.1 Uni-Functional Smart Paints
- 3.6 Eight-Year Forecasts
- 3.7 Key Points from This Chapter

## **CHAPTER FOUR: MULTIFUNCTIONAL SMART MATERIALS IN THE AUTOMOTIVE INDUSTRY**

- 4.1 Multifunctional Automotive Surfaces and the Future of the Automotive Industry
  - 4.1.1 Factors Shaping the Multifunctional Surfaces Market in Automotive
  - 4.1.2 The Automobile Market: 2016 and Beyond

- 4.2 Current Automotive Coating Practices and Multifunctionals
  - 4.2.1 How Multifunctional Surfaces May Evolve in the Automotive Sector
  - 4.2.2 Multifunctional Materials and the Trend Towards Smartness in Cars
- 4.3 Mapping Multifunctional Smart Materials in Automotive
  - 4.3.1 Clean and Heal: Two Smart Functions that will Combine
  - 4.3.2 Interior vs. Exterior Surface Multifunctionality
- 4.4 Automotive Glass and Multifunctional Smart Surfaces
  - 4.4.1 Self-Dimming Mirrors: Building On a Successful Platform
  - 4.4.2 Windows and Windshields: Better Prospects for Multiple Smart Functions
- 4.5 Interior Surfaces: Selling Clean with Interactivity
  - 4.5.1 The Appeal of Antimicrobial-based Smart Interior Surfaces
  - 4.5.2 Shifting Landscape of Interiors Development: Implication for Smart Surfaces
  - 4.5.3 Will Driverless Vehicles be the Tipping Point?
  - 4.5.4 Color Shifting
- 4.6 The Business Case for Smart Car Exterior Surfaces
  - 4.6.1 Hydrophobic Surfaces on Automotive Surfaces: A Platform for Multifunctionality
  - 4.6.2 A Note on Color Shifting for Automotive Exteriors: Multifunctional Implications
- 4.7 Supplier Landscape: Everyone On Board
- 4.8 Eight-Year Forecasts
- 4.9 Key Points from This Chapter

## **CHAPTER FIVE: MULTIFUNCTIONAL SMART MATERIALS IN AEROSPACE**

- 5.1 Why Smart Materials Sell in Aerospace
  - 5.1.1 Potential Multifunctional Smart Materials
- 5.2 Smart Windows in Aerospace: A Platform for Multifunctional Smart Materials?
  - 5.2.1 Moving Smart Aircraft Windows to a Smart Multifunctional Platform: Low Potential for Now
- 5.3 Multifunctional Smart Materials for Detecting and Repairing Damage
  - 5.3.1 SHM and its Growth towards Multifunctionality
  - 5.3.2 How Multifunctionality Can Create More Value in Self-Healing Aircraft
- 5.4 PV, Multifunctionality and Planes
- 5.5 Challenges for Smart Materials in Aerospace
  - 5.5.1 Demanding Performance Requirements
  - 5.5.2 Need to Comply with Aerospace Materials Standards: NASA
- 5.6 Multifunctional Smart Exterior Surfaces in Aerospace: Project Examples
  - 5.6.1 Luna Innovations and Ultratech International
  - 5.6.2 Lufthansa Technik
  - 5.6.3 NanoSonic and NASA

- 5.6.4 The EU AEROMUCO Project
- 5.7 Multifunctional Smart Materials for Interior Surfaces
- 5.8 Eight-Year Forecasts
- 5.9 Suppliers: Squeezing Everyone Into the Picture
- 5.10 Key Points from This Chapter

## **CHAPTER SIX: OTHER MARKETS WITH POTENTIAL FOR MULTIFUNCTIONAL SMART MATERIALS: MULTIPURPOSE VERSUS SMART MULTIFUNCTIONALITY**

- 6.1 Nice Niches: Sketching Out the Boundaries
- 6.2 Medical and Healthcare
  - 6.2.1 The Opportunity for Multifunctional Smart Surfaces in the Healthcare Market
  - 6.2.3 Fabrication of Smart Multifunctionals in the Healthcare Market
  - 6.2.4 Reality Check: How Big is This Market Potential for Medical Multifunctionals
  - 6.2.5 Forecasts for Multifunctional Smart Materials in Medical and Healthcare
- 6.3 Multifunctional Smart Materials and Textiles
  - 6.3.1 A Stronger Case for Cleanliness
  - 6.3.2 Making the Business Case for Multifunctional Smart Textiles
  - 6.3.3 Technology Choices
  - 6.3.4 Challenges for Multifunctional Materials in the Textile Market
  - 6.3.5 Forecasts for Multifunctional Smart Materials in Textiles and Clothing
- 6.4 General Consumer Products: The Future of Clean and Anti-Scratch
  - 6.4.1 Selling the 'Uncleanliness Factor'
  - 6.4.2 Appearance Considerations
  - 6.4.3 Forecasts for Multifunctional Smart Coatings and Surfaces in Consumer Products
- 6.5 Consumer Electronics and Multifunctional Smart Materials
  - 6.5.1 Making Smartphones Smarter, with Materials
  - 6.5.2 Why Moving to Multifunctional Makes Sense
  - 6.5.3 How Much do End-Users Really Care?
  - 6.5.4 Market Watch: Multifunctional Smart Materials in Consumer Electronics
  - 6.5.5 Forecasts for Multifunctional Smart Materials in Consumer Electronics
- 6.6 Key Points from this Chapter

## List Of Exhibits

### LIST OF EXHIBITS

Exhibit E-1: Summary of Ten-Year Forecast of Smart Multifunctional materials by End User Sector

Exhibit E-2: Summary of Ten-Year Forecast of Smart Multifunctional by Type of Materials

Exhibit 2-1: Multifunctionality Roadmap for Smart Materials

Exhibit 2-2: Advantages of Printing for Fabricating Low-Cost Sensors for Smart Surfaces

Exhibit 3-1: Potential Multifunctional Smart Materials in Buildings

Exhibit 3-2: Strategic Possibilities for Multi-functional Smart Windows Platform

Exhibit 3-3: Smart Composites Used in the Construction Industry

Exhibit 3-4: Players and Products in the Self-Cleaning Materials Space

Exhibit 3-5 Ten-Year Forecast of Smart Multifunctional Materials in the Construction Industry

Exhibit 4-1: Pairings of Smart Functions in Automotive Interiors and Exteriors

Exhibit 4-2: Selected SPD Licensees

Exhibit 4-3: Hydrophobic Materials in Vehicle Exteriors

Exhibit 4-4 Ten-Year Forecast of Smart Multifunctional Materials in the Automotive Industry

Exhibit 5-1: Multifunctional Smart Materials in Aerospace

Exhibit 5-2: Self-Healing/Damage-Detecting Projects

Exhibit 5-3 Ten-Year Forecast of Smart Multifunctional Materials in the Aerospace Industry

Exhibit 6-1: Niche Markets for Multifunctional Smart Materials

Exhibit 6-2: Ten-Year Forecast of Smart Multifunctional Materials in the Healthcare and Medical Market

Exhibit 6-3: Cases for Multifunctional Smart Textiles

Exhibit 6-4: Ten-Year Forecast of Smart Multifunctional Materials in Clothing and Textiles

Exhibit 6-5: Ten-Year Forecast of Smart Multifunctional Materials in Consumer Products (Including Consumer Electronics)

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