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Conductive Coatings Markets 2010 & Beyond

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Conductive Coatings Markets, 2010 and Beyond

NanoMarkets has been providing analytical coverage of the conductive coatings market for more than three years and has developed an insider's knowledge of this interesting market. In this new report, we have leveraged this knowledge and identified where the main opportunities in conductive coatings will be found in the next eight years.

In this new report, we have examined the latest technical and market developments in the conductive coatings space. What we have discovered is a growing number of applications where the market is open to new conductive coatings and new suppliers.

In particular, we have looked at the new business revenue opportunities for conductive coatings that are emerging from developments in the display, lighting, solar panel, battery and sensor markets. And we have been especially careful to provide coverage of the how the maker of conductive coatings can capitalize on such trends as the growth in e-paper and touch-screen displays and the resurgence of crystalline silicon photovoltaics.

But in addition to such specialized, high-performance applications, this report also looks at new opportunities for bulk conductive coatings used for electrostatic discharge (ESD) and EMI/RFI protection. These application areas for conductive coatings were once considered slow growth, but the onward march of Moore's Law and of wireless communications has transformed this sector into one that has much greater potential than ever before:.

· NanoMarkets expects that antistatic coatings for packaging and industrial clothing are likely to see a boom as feature sizes decrease. With the semiconductor industry about to move beyond the 45-nm node, antistatic coatings are becoming increasingly essential in electronics packaging, as well as for the clothing and furniture used in the electronics industry.

· The coatings used for EMI/RFI shielding are also likely to see solid growth with the main driver being the shift of computing and communications from wired to wireless.

For this report we have analyzed the market at four main classes of conductive coatings. These are metals, metallic oxides, conductive polymers and nanomaterials. We discuss the latest technical and commercial developments and latest materials that area appearing on the scene, such as graphene and nanomaterials substitutes for ITO.

As with all NanoMarkets reports, this report includes a detailed eight-year forecast of conductive coatings markets by application and material and it also provides an in-depth discussion of key materials suppliers and other firms active in this space. With regard to the forecast we have taken into consideration the latest pricing expectations for the materials involved.

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Chapter One: Introduction

1.1 Background to this Report

NanoMarkets has been covering the conductive coatings business in one form or another for at least five years. This particular report is the second that NanoMarkets has produced that focuses specifically on conductive coatings. We note, however, that *much of the conductive coatings business involves mature applications catered to by equally mature materials. In this sense, many of the segments that make up the conductive coatings business do not present any real opportunities, nor are they likely to in the future.*

1.1.1 New Applications for Conductive Coatings Emerging

This does not mean that these segments generate minimal revenues, but rather that there are established suppliers that are hard to compete with and the profitability is hardly worth the prize. That said, *there seem to be a growing number of applications where the market is open to new conductive coatings and new suppliers. It is such areas that this report and its ancestors focus on. Each of these areas, we believe, is dynamic enough to warrant annual analytical coverage; and this is the main objective of this report.*

Although the emerging opportunities for conductive coatings are hard to classify precisely, we see most of them as falling into three categories. Arguably the most important category is the conductive coatings used for contacts and electrodes for new types of electronics, optical devices, batteries and photovoltaics panels.

But the story is bigger—much bigger—than this. *Antistatic coatings for packaging and industrial clothing is likely to see something of a boom as the semiconductor industry moves down the path set for it by Moore's Law. As the node size decreases, the concern about damage from static electricity and vagrant currents becomes more important. With the semiconductor industry about to move beyond the 45-nm node, antistatic coatings are becoming increasingly essential in electronics packaging, as well as for the clothing and furniture used in the electronics industry.*

The conductive coatings used for antistatic applications are mostly bulk materials and this is also true for the coatings used for EMI/RFI shielding, which NanoMarkets believes is another area of growing importance with main driver being the of computing and communications becomes from wired to wireless. We note that in this report, we have given considerable more attention to both EMI/RFI and antistatic applications than in previous applications.

1.1.2 Growing Number of Conductive Coatings Materials Choices

That these three areas are important is fairly easy to understand. *However, what makes the conductive coatings business much more of a complex market that is in need of analysis is that in many cases, the materials choices for the conductive coatings used in these dynamic areas have yet to be finally settled on. For example, if the inevitable solution to EMI shielding was always layer of copper (a solution widely used in the past), there would be little to talk about in a report such as this.*

Traditionally, and for obvious reasons, conductive coatings have been metals. The major exception to this rule is where the coating has had to be transparent as well as conductive; this is the case in the display and solar panel industry for example. In such cases, transparent conductive (metal) oxides (TCOs) have been used, with indium tin oxide (ITO) being widely used because of its relative good tradeoff between transparency and conductivity.

However, the conductive coatings market is dynamic on the supply side as well as on the demand side. There have always been complex tradeoffs between costs and performance in the conductive coatings market and these continue to raise challenges and opportunities, but the appearance of nanomaterials and conductive polymers in commercial conductive coatings has only made the choice of materials more complex, and consequently the opportunities for suppliers of conductive coatings that much greater. Materials selection for conductive coatings may also be impacted by the current worldwide recession. Where a designer might have been cautious about using an indium- or silver-based coating a year ago because of the high price of such metals, in today's economy these coatings could have acceptable economics.

Conductive polymers: Conductive polymers are one of the major classes of novel advanced materials that have proven to be a major boon to industry over the past couple of decades. The poster child for the rise of conductive polymers is H.C. Starck's PEDOT:PSS material. This has been used for some time in electrostatic applications, but is now beginning to find a new—and higher value—role as an electrode material for novel electronics applications.

It has even been used for OLED lighting electrodes, in the touch-sensitive subsystems of touch-screen displays and in fuel cells. Still, conductive polymers are not without their issues in the context of high-end conductive coatings. In particular, they have relatively low conductivities, which represents an opportunity for polymer firms and some companies are already pursuing it. For example, Ormecon in conjunction with its partner Nissan Chemical Industries has demonstrated polymer materials that are climbing the conductivity ladder.

We not also that polymer materials seem to have a growing opportunity in EMI/RFI shielding; the most commonly used conductive polymers in EMI/RFI are polypyrrole and polyaniline, due to their low cost and good electrical conductivities. Water-based polymer conductive coatings have shown the unique ability to transform surfaces into functional antennae, thereby radically changing the way that communication systems can be linked. Such coatings block external access to wireless signals including WiFi networks and can contain and isolate EMI given off by electronic equipment.

Nanomaterials: *One materials trend that seems potentially likely to open up the conductive coatings market to new opportunities, applications, and even new players is the use of nanomaterials.* The two key points about these materials that bear noting are that (1) they have a potential to radically improve the performance of coatings and (2) they are just at the beginning of the technological evolution, while almost all the other materials discussed in this report are either very mature (e.g., ZnO) or at least well understood (conductive polymers). The implications are that nanomaterials have the potential to lead to performance gains that none of the other classes of materials discussed in this report can offer.

Nanomaterials-based coatings include two kinds of products. First there are those materials that are structurally quite similar to more traditional coatings, but use nanoparticles, rather than conventional constituents. Because we are talking about *conductive* coatings here, the nanoparticles in question are often *silver* nanoparticles, although the use of copper nanoparticles is not unknown. Silver nanoparticles are sometimes found as the primary constituent of the coating, paste or inks, as is the case with the handful of silver nanoinks and nanopastes meant to provide a high conductivity substitute for traditional thick film inks. Or nanosilver can be mixed with other materials to produce better cost/performance tradeoffs. Nanosilver has even been used in *transparent* conductive coatings, as is the case in the Cambrios product.

The other kind of conductive “nanocoating” makes use of nanostructures; principally carbon nanotubes (CNTs). Graphene or non-carbon nanostructures could also serve in the same way, but are in no way as developed commercially. As an aside, we note that CNT coatings seem likely to be one of the first practical applications for carbon nanotubes in electronics. While some of the more romantic visions of high-performance carbon nanotube transistors have never really panned out, CNT-based conductive coatings seem to have real commercial value here and now. They may even lead to the first transparent conductive coating that can offer a better mix of transparency and conductivity than ITO. The two companies that have been pushing carbon nanotube coatings in this way are Unidym and Eikos.

1.1.3 Back to Tradition: New Options for TCOs and Metals

The exciting developments in the areas of advanced materials and nanomaterials should not be allowed to obscure the fact that there are developments in the more traditional sectors of the conductive coatings market that are worth noting and that will have impact on strategy and revenue earnings potential.

Thus in the TCO segment we note the growing number of oxides that are being used as conductors. Often the opportunity for these materials is as an ITO substitute, but there is a broader range of electrode applications for oxides and in some cases, the role of oxides spills over into the optical coatings field; for example, in UV filter applications, metal oxides promise a whole new class of semiconductor devices. Among the materials that have proven useful in this way are various zinc oxides and tin oxides doped with a wide variety of materials such as antimony, fluorine, aluminum, indium and gallium.

Finally, it is worth noting that the conductive coatings market continues to be affected by developments in the original kind of conductive coatings—metals. There are new ways to deposit some kinds of metals. Printing—of silver and copper, in particular—is now a practical alternative to older coating approaches. In addition, metals can be mixed with other materials to form novel conductive coatings of various kinds. For example, Syscom Advanced Materials in conjunction with NASA has developed the AmberStrand metal-clad polymer coating, which produces highly conductive yarn and has effectively replaced the commonly used beryllium copper CS95 wire. This novel material is being used for signal transfer and EMI shielding in wiring and cable applications.

1.1.4 Differences from NanoMarkets 2009 Conductive Coating Report

While this report covers similar ground to the 2009 report on conductive coatings published by NanoMarkets it differs in a number of ways:

- We have updated the forecasts to reflect the changing worldwide economic circumstances and the latest pricing expectations for the materials involved. We have also added more granularity to these forecasts. These additions are based on the additional research on both applications and materials that NanoMarkets has conducted since the last publication.

- We have added more detail with regard to the applications for conductive coatings. In some cases – as in the section on solar panels – we discuss in more depth than before how changes in design are impacting materials choices. In other sections, we have added new applications; for example we have added sections on what the surge of interest in e-paper and touch-screen displays will mean to the conductive coatings world.

- We have added in depth discussions of the recent developments in new materials, especially nanomaterials and transparent conductors. In particular, we have more to say about nanotube/graphene coatings and about the latest twists and turns in the ITO versus ITO substitutes.

1.2 Objectives and Scope of this Report

The objective of this report is to analyze and forecast the market opportunities that are emerging in the conductive coatings market, with a focus on the materials and applications areas outlined above. It identifies and quantifies the opportunities for conductive coatings in a wide variety of applications including batteries, solar panels, lighting, displays and a variety of other areas.

This report focuses especially on applications that are currently calling for novel conductive coating materials. It also identifies and compares the major candidate materials for this role and how they fit with various product designs, and production technologies. The report discusses the product strategies of major materials firms that are involved in this space and also includes complete review of commercialization efforts of conductive coating developers.

By reviewing each of the various market segments we show where new business revenues will be created in the next eight years. This report also provides detailed eight-year market forecasts for the use of conductive coatings. These forecasts are provided at the end of this report and are broken down by material type and application.

As mentioned above, our primary interest is in coatings that are used to create electrodes and contacts as well as in coatings used for antistatic and EMI/RFI applications. However, in some cases we go beyond these applications. With regard to materials, our main interest is in metals, conductive polymers, nanomaterials, oxides of various kinds, and materials that are in some sense hybrids of two or more of these materials. In this report, we have examined certain aspects of the printed electronics market where novel coating materials are being used.

As such we have taken a broad view on what processes are included under the heading of “coatings.” Generally, what we have in mind is what is usually termed roll-to-roll coating or web coating, but we consider any application of thin-film conductive material on a substrate fair game for this report. However, we limit our discussion of printing to where it has a coating- (i.e., deposition) like aspect to it and is not too oriented toward patterning. We are not primarily concerned with processes that are used in large-scale integration in the semiconductor industry. However, we have included discussions of physical vapor deposition (PVD), chemical vapor deposition (CVD) and sputtering where this seems appropriate. Our primary concern in this report is with coatings, rather than inks. In practice, there is a fine line between the two categories and no doubt we cross that line from time to time in this report. However, from our perspective we think of printing and hence inks as being used where some kind of fine detail such as a conductive trace or even a thin-film transistor is being created. Coating in our terms of reference is when one coats or paints on a surface of some kind, with no intent of creating an object as such, just a covering.

Because the area of conductive coatings is so large, it has clearly not proved possible to cover the market opportunities presented by every available niche material or application. Instead, we have focused where the greatest opportunity is and we also acknowledge that the focus of the report is primarily toward areas that fall into the electronics industry in one form or another.

Finally, this report is intended as a report covering worldwide markets. Where there are specific national or regional differences we note this in the main body of the report. This report is entirely international in scope. The forecasts are worldwide forecasts, and we have not been geographically selective in the firms that we have covered in the report or interviewed in order to collect information.

1.3 Methodology of this Report

Our assessment of the various markets considered in this report is based on interviews with manufacturers of materials for a host of applications. In addition, we have also based our conclusions on NanoMarkets' ongoing industry analysis program, which covers many areas of thin-film, organic and printable electronics.

The secondary research for this report drew on the World Wide Web, commercial databases, trade press articles, technical papers, SEC filings and other corporate literature. NanoMarkets' researchers have also frequently attended and spoken at important trade shows and conferences related to the subject matter discussed in this report.

This report forms part of a series of reports published by NanoMarkets covering new directions in the commercialization of materials for thin-film organic and printable electronics. Other areas covered by NanoMarkets' reports include analyses of the markets for OLED materials, materials for functional inkjet printing, and materials markets for thin-film and organic photovoltaics, zinc oxide and ITO.

1.4 Plan of this Report

In Chapter Two of this report, we take an in-depth look at the full range of existing and novel conductive coating materials available at major companies and research institutions, from the perspective of technology and material science and how this impacts performance, product design and manufacturing issues.

In Chapter Three, we analyze the evolving markets for conductive coatings in printed electronics and other industries. The goal of this chapter is to identify the niches and sectors that represent opportunities, as well as the materials and performance requirements for these areas.

Finally, Chapter Four provides our eight-year forecasts for conductive coatings in the various sectors discussed in this report.