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Nano-Enabled Batteries for Portable and Rechargeable Applications – Types, Applications, New Developments, Industry Structure and Global Markets

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Nanostructured or nano-enabled batteries are a new generation of lithium-ion batteries and battery systems to serve applications and markets outside the historical domain of lithium-ion.

Nano-enabled batteries employ technology at the nanoscale, a scale of minuscule particles that measure less than 100 nanometers, or 100x10-9 meters. In comparison, traditional lithium-ion (Li-Ion) technology uses active materials, such as lithium cobalt-oxide or lithium iron phosphate, with particles that range in size between 5 and 20 micrometers. Nano-engineering improves many of the failings of present battery technology, such as re-charging time and battery “memory”. Researching battery micro- and nanostructure is a whole new approach that is only just beginning to be explored

Industrial production of nano batteries requires production of the electrode coatings in large batches so that large numbers of cells can be produced from the same material. Manufacturers using nano materials in their chemistry had to develop unique mixing and handling technologies.

This report is focused on high performance batteries that are based on nanoscale materials, which are being used in cordless electric tools, notebooks and adoption in plug-in hybrid electric vehicles (PHEVs), HEVs, which are the next great transportation advance that will move us into a cleaner, cheaper, and more oil-independent future. A nano battery that outlasts the car will greatly improve the economics of hybrids versus traditional cars.

This report analyzes the worldwide markets for nanostructure-enabled batteries already using nano lithium iron phosphates, nano titanium oxide, silicon/graphite composites, and other developments in nanometals, carbon nanotubes, nanocrystalline materials, nanowires and polymer nanocomposites specifically related to batteries.

The report provides separate comprehensive analyses for the U.S., Japan, western Europe, China, Korea, and the rest of the world. Forecasts are provided for each region for the period 2008 through 2013. Cost analysis of nanostructured batteries, analysis of global patents activity and market competition and dynamics in the new technology are also covered in the report. The report profiles 44 companies, including many key and niche players worldwide as technology providers, raw material suppliers, nano batteries assemblers and users.

STUDY GOAL AND OBJECTIVES

This study focuses on nano-enabled batteries, providing market data about the size and growth of application segments, new developments, a detailed patent analysis, company profiles and industry trends. The goal of this report is to provide a detailed and comprehensive multi-client study of the market in North America, Europe, Japan, China, India, Korea and the rest of the world (ROW) for nanostructured batteries,

and potential business opportunities in the future.

The objectives include thorough coverage of the underlying economic issues driving the nano-enabled batteries, as well as assessments of new advanced nano-enabled batteries that are being developed. Another important objective is to provide realistic market data and forecasts for nano-enabled batteries. The study also provides extensive quantification of the many important facets of market developments in nano-enabled batteries all over the world. This, in turn, contributes to the determination of what kind of strategic responses companies may want to adopt in order to compete in this dynamic market.

The report identifies the trends and strategies driving nano-enabled battery market segments, and focuses on detailed market share data and quantification in transport, specialty vehicles, power tools and portable consumer electronics devices.

REASONS FOR DOING THE STUDY

Current battery technologies are limited, making plug-in hybrid or all-electric cars prohibitively costly and insufficient to meet consumer demands. Long term, fundamental research in electrical energy storage will be needed to accelerate the pace of scientific discoveries and to see transformational advances that bridge the gaps in cost and performance, separating the current technologies and those required for future utility and transportation needs.

The nanoscale dimensions that let energy move rapidly also allow the battery to recharge faster when the energy flow is reversed, a feature that is important for hybrid cars that are designed to harvest energy from braking and use it to recharge the batteries.

With all these new developments, iRAP felt the need to conduct a major study covering technology, application, industry dynamics and markets for nano-enabled batteries.

CONTRIBUTIONS OF THE STUDY

The report provides the most thorough and up-to-date assessment that can be found anywhere on nano-enabled batteries. The study provides extensive quantification of the many important facets of market developments in the emerging markets of these batteries, as, for example, in high power density and high energy density electric energy sources. This, in turn, contributes to the determination of what kind of strategic responses suppliers may adopt in order to compete in this dynamic market. The report goes on to analyze the prospects of different technologies and applications.

SCOPE AND FORMAT

The market data contained in this report quantifies opportunities for nano-enabled batteries. In addition to product types, it also covers the many issues concerning the merits and future prospects of the nano-enabled battery business, including corporate strategies, information technologies, and the means for providing these highly advanced products and service offerings. It also covers in detail the economic and technological issues regarded by many as critical to the industry's current state of change. The report provides a review of the nano-enabled battery industry and its structure, and the many companies involved in providing these products. The competitive position of the main players in the nano-enabled battery market and the strategic options they face are also discussed, as well as such competitive factors as marketing, distribution and operations. The report provides profiles of leading firms active in this space.

Besides producers and users of nano-enabled batteries, the present survey also indentifies suppliers of nano materials required for the manufacture of electrodes and electrolytes and separators. The report also presents the status of ongoing research at leading institutes around the world. The role of venture capitalists and government funding agencies in the development of nano-enabled battery technology also is highlighted.

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TO WHOM THE STUDY CATERS

The study will benefit the existing users of batteries who are looking for the dense chemistry of nano-enabled batteries, which are rated as being able to accept a power pulse of 100 times rated capacity, compared to other "advanced" batteries which are rated at only 20 times capacity. It is specifically engineered as a power battery able to supply short bursts of electrical energy, as opposed to a battery designed for longer, slower power drains, such as is found in an electric car. This makes it ideal for use in hybrid-electric cars as well as other applications including lawn care and garden equipment.

Since this study provides a technical overview of the nano-enabled batteries, especially recent technology developments and existing barriers, audiences for this study include directors of technology, marketing executives, business unit managers, and other decision makers in markets for hybrid electric vehicles, plug-in hybrid vehicles, electric vehicles, light electric vehicles, utility vehicles, power tools and laptops, as well as those in companies peripheral to these businesses.

More specifically, the report will be of interest to:

- firms in the battery and power spaces who want to understand the next wave of opportunities and how the new battery and fuel cell technology will impact them in the future;
- manufacturers and developers of advanced materials and components, as well as sub-contract manufacturing companies who need to analyze the potential for selling their products and services into the nano lithium ion battery power segment;
- automotive, power tool and electronic portable consumers of batteries who need information on the power capabilities and power management requirements of future systems;
- investment bankers, venture capitalists and private equity investors who need a realistic appraisal of the revenue potential and timeframes associated with the advanced energy storage technologies based on nanostructured materials.

REPORT SUMMARY

Nanotechnology innovations are driving advances in battery technology where nanomaterials are finding use as new battery materials. Enormous leverage can result from advances in cathodes, anodes and electrolytes used in the batteries. The current focus of nano-enabled batteries is on lithium-ion batteries. Lithium-ion cells represent the basic building blocks of batteries proposed for the next generation of advanced hybrid electric vehicles (HEVs), electrical vehicles and specialty vehicles.

The calendar life of high-power lithium-ion battery cells is expected to have the same basic dependence on temperature as high-energy cell designs, because several of the high-power cell technologies use the same basic chemistry as larger cells and thus are subject to the same kind of degradation processes.

The next generation of lithium-ion batteries has improved safety characteristics, in part through the use of alternative nano-sized materials, in particular, nano-phosphate materials. Traditional lithium-ion technology uses active materials with particles that range in size between 5 and 20 microns.

The greater density of particles provides more surface area on which the ions can travel and generate additional power. In essence, battery power is derived from the diffusion of lithium ions moving in and out of particles. When particles are smaller but more numerous, that equates to greater diffusion and much faster kinetics than would be generated with one large particle.

The use of phosphates, in lieu of oxides, for the nanomaterials is one reason for these increased power rates and temperature ranges. Both phosphates and oxides are naturally occurring substances that are used in battery cathodes. Traditionally, oxides such as iron and cobalt have been used for battery cathodes. But, in the 1990s, scientists began to experiment with nano-phosphates, which industry experts say are inherently safer than oxides because they are stable in overcharge or short-circuit conditions and

withstand high temperatures without decomposing.

The iRAP study identified over a dozen manufacturers and developers of nano-enabled batteries. These companies are driving the technology to meet market needs. There are also over 20 suppliers of nanomaterials used in nano-enabled batteries.

Major findings of this report are:

- The global nano-enabled battery industry is characterized by over a dozen companies involved in the industry as manufacturers and developers.
- The 2008 global market was estimated at $169 million and expected to grow, at an impressive annual average growth rate of 46.3%, to reach $1.13 billion by 2013.
- Among the three types of nano-enabled batteries, customized batteries for power tools had the highest market share of 59.2% in 2008, followed by large format modules with 37.8%, and a small 3% share for fast charging customized nano safe battery for laptops.
- By 2013, large format modules for hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), electric vehicles (EVs) and specialty vehicles will have 84.7% of the global market, with an AAGR of 71.8% from 2008 to 2013.

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