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## Nanotechnology in Germany: Market Report

2013-07-29

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The research and development efforts in the science sector play a significant role in [Germany](#)'s economy. The development of new technologies like nanotechnology has great economic potential and [Germany](#) has a great number of companies that focus on the development, application and distribution of nanotech-based products.

[Germany](#), through the Federal Ministry of Economics and technology is working to create an innovation-friendly environment, promoting market-oriented research, development and innovation projects.

They are looking to accomplish this via their innovation strategy which will:

- Introduce tax breaks for research and development activities
- Encouraging small and medium sized businesses to innovate

- Introduce new investment grants for venture capital
- Provide funding via the recently established new European Angels Fund
- Provide seed finance for high-tech start-ups
- Initiate 200 innovative university-based business start-ups

In 2011, [Germany](#) had 34,000 research companies and 110,000 innovative companies, and ranked 3rd in the EU Commission's Innovation Union Scoreboard behind [Sweden](#) and [Denmark](#). They are committed to maintaining this ranking and in the process increasing the number of research companies to 20,000 and innovative companies to 140,000 by the year 2020.

## Nanotechnology Organizations

A brief introduction to the key nanotechnology-related organizations in [Germany](#) is given below:

**[NanoTUM](#)** - The TUM Institute of Nanoscience and Nanotechnology focuses on coordinating research and education in nanotechnology and nanoscience. This institute conducts research activities through theoretical and experimental approaches. Some of the research areas include metallic nanostructures, nanocrystalline semiconductors, nanophotonics, nanosensors etc.

**[Cluster Nanotechnology](#)** - Explores the potential of nanotechnology by cross-linking nanotechnology competences from politics, economy and science. Some of the nanotechnology projects initiated by Cluster Nanotechnology include:

- NanoSilber network
- Network for nanoanalytics
- Network for nanotechnology-based optical sensor systems
- NanoBRIDGE Network – Bridge between German and Russian nanotechnology excellence

**[Nanovalley](#)** - Supports innovative activities in various enterprises and focuses on transferring research results into new businesses and products. This organization supports research conducted by universities and companies that work towards the same goal of using

nanotechnology for future developments.

**[Bioanalytik-muenster](#)** - Focuses on the study and research of nano-bioanalytics by developing strong contacts between the business and science sectors to ensure rapid exploitation of research results for product development, generating financial support and increasing the nanobioanalytical potentiality.

**[cc-NanoBioNet](#)** - A non-profit organization that supports research and development by bringing together companies, universities, hospitals and research institutes. Their key focus areas include:

- Nanoethics and nanosafety
- Chemical nanotechnology
- Pharmaceutical biotechnology
- Nanobiotechnology

**[The NanoNetzwerkHessen](#)** - Concentrates on the funding of enterprises dealing with nanotechnology and materials technology. This organization plays a vital role in strengthening the international competitiveness and innovative ability in various small- and medium-sized companies.

**[Fraunhofer Nanotechnology Alliance](#)** - A research organization that serves to meet the needs of people through their research activities and also by designing and developing new products and improving techniques. This organization undertakes applied research of direct utilities to private and public companies.

## **Nanotechnology Companies**

Some of the major nanotechnology-focused companies in [Germany](#) are listed below along with brief introductions to each of them:

**[Accurion](#)** - Accurion GmbH is dedicated to provide high end reliable state of the art technology for its two product lines - Imaging Ellipsometry and Active Vibration Isolation.

Accurion was formed out of Halcyonics GmbH, a specialist in Active Vibration Isolation Solutions, and NanofilmTechnologie GmbH, specialist for surface analysis tools like Imaging Ellipsometry and Reflection Spectroscopy.

**Aixtron** - Aixtron produce Metal Organic Chemical Vapour Deposition (MOCVD) systems for applications such as LEDs, power electronics, and photovoltaic materials. To date, AIXTRON has delivered more than 2,000 deposition systems to customers around the world.

**Anfatec** - Anfatec was founded by two members of the Chemnitz University of Technology in 1996. Anfatec develops, produces and sells scientific instruments for surface science, mainly Scanning Probe Microscopes, controllers and components for Scanning Probe Microscopes.

**Aquanova** - AQUANOVA was founded in 1995 as AquanovaGetränketechnologie GmbH with headquarters in Mannheim. AQUANOVA is a technologically leading supplier of solubilisates and nanoscale encapsulation for nutrition as well as the health, cosmetics, pharmaceutical and general industries.

AQUANOVA is a solution provider to the food, health, cosmetics and pharmaceutical industries utilizing its nanoscaled liquid formulas ("solubilizates"). They empower industry customers to create superior health oriented product features and to enhance quality and durability.

The NovaSOL® product range makes these so called solubilisates available for a broad spectrum of materials such as vitamins, coenzyme Q10, omega-3 fatty acids, food colours, plant extracts or preserving agents.

**Attocube Systems** - 'Trusted to Deliver Excellence' is central to attocubesystems' company philosophy. It is what drives them in every aspect of their business. It is the promise they make to their customers. In today's competitive environment it is not enough to build great products: their customers are looking to them to deliver the best in service solutions. When they do, they build enduring relationships with their customers and their partners.

Their application fields include quantitative magnetic characterization on the nanoscale, optical emission from carbon nanotubes, anofocusing parabolic refractive X-Ray lenses, nanomanipulators/nanogrippers etc.

**BASF** - "For BASF, nanotechnology is not only an important area of research, but also the key to numerous innovations. For example, nanomaterials with new functionalities are innovation

drivers in many business areas, such as health, electronics, housing and construction, automotive and energy." Dr. Andreas Kreimeyer, Research Executive Director, BASF.

**Bayer MaterialScience** - As a market and customer oriented inventor company, Bayer MaterialScience is promoting the development of carbon nanotubes (CNT). For example, Bayer MaterialScience's own laboratories are currently perfecting the cost effective industrial production of CNTs, because the demand for innovative, intelligent and environmentally friendly market solutions is growing all the time. And the efforts of this company are entirely in line with the Bayer Group's guiding principle: "Science For A Better Life".

**Bruker** - Founded in [Germany](#) in 1960, and currently headquartered in Massachusetts, [USA](#), Bruker has been driven by the idea to always provide the best technological solution for each analytical task for more than 50 years. Bruker continues to build upon its extensive range of products and solutions, its broad base of installed systems and a strong reputation among its customers. Being one of the world's leading analytical instrumentation companies, Bruker is strongly committed to further fully meet its customers' needs as well as to continue to develop state-of-the-art technologies and innovative solutions for today's analytical questions.

**CAN** - The Center for Applied Nanotechnology (CAN GmbH) is a technology service provider that promotes utilization of new findings in chemical nanotechnology and nanoanalysis for companies and research facilities in [Germany](#) and abroad.

CAN helps to solve specific problems of customers in contract research projects or work together with our partners in national and international research programs. With their broad expertise, technologies developed in-house, a teamwork-based culture and an intense exchange of information, CAN makes added value for our customers our priority.

**Capsulation** - They are a leading nanotechnology enterprise specialized in the customer-specific development of tailored, innovative and market-oriented drug delivery solutions that perfectly meet the needs of their customers.

As a spin-off of the Max Planck Society, their enterprise is a pioneer in the commercial utilization of the latest research results from the field of nanotechnology. They are opening up new frontiers by applying nanotechnology to the modern challenges of pharmaceutical therapy, medical technology and diagnostics.

**Carl Zeiss Microscopy** - Throughout the world the name of Carl Zeiss stands for the highest quality and reliability. The Carl Zeiss group is a leading organization of companies operating worldwide in the optical and optoelectronic industry. Carl Zeiss is heavily involved in the world of nanotechnology through its Microscopy, Semiconductor Manufacturing and Industrial Metrology business units.

As a world leading manufacturer of both light and electron microscopes, Carl Zeiss Microscopy manufactures compound light microscopes as well as a diverse range of fluorescence optical sectioning systems, electron and ion microscopes.

Carl Zeiss Semiconductor Manufacturing Technology has a broad product portfolio covering a wide range of key processes in microchip manufacturing, including optical lithography and mask optimization. Zeiss systems enable chip manufacturers to produce microchips that are ever smaller, faster and more energy-efficient per functional unit. Carl Zeiss have also taken the first step into the future microchip production with EUV lithography.

**Dreebit** - Their business focus is development, fabrication, sales and distribution, and service of vacuum equipment and components, and facilities for micro- and nanotechnology based on ion and electron beam techniques. They organize commission and deliver services for equipment, instruments, and components for vacuum technology.

**Evonik Industries** - Evonik is one of the world's leading specialty chemicals companies. Their specialty chemicals activities focus on high-growth megatrends - especially health, nutrition, resource efficiency, and globalization - and their goal is to enter attractive future-oriented markets.

Evonik uses nanotechnology to develop innovative products and efficient solutions and to enhance processes. In this way they make an important contribution to protecting the environment, improving health and making lives more comfortable.

The company regards nanotechnology as a key technology of considerable commercial importance. They believe this new technology opens up enormous opportunities to improve the production and storage of energy, and in areas such as surface refinement and mobile electronics, catalysts that increase the efficiency of production processes and minimize the use of resources, as well as in cosmetics and abrasion-resistant ceramic components.

**Fries Research and Technology** - Fries Research & Technology GmbH (FRT) offers 3D surface metrology system for research and production. The main activities are the development, production and worldwide distribution of measurement equipment and

software for metrology measurement of surfaces with micro- and nanometer resolution.

**[FRITSCH](#)** - FRITSCH is an internationally respected manufacturer of application-oriented laboratory instruments. FRTISCH instruments have been used for decades worldwide for Particle Size Analysis, Particle Size Reduction and Sample Preparation in industry and research laboratories.

**[FutureCarbon](#)** - FutureCarbon specializes in the development and manufacture of carbon nanomaterials and their refinement to create what are called carbon super-composites or primary products for further processing by industry. Carbon super-composites are combinations of materials that unfold the special characteristics of carbon nanomaterials in the macroscopic world of real applications. All of their materials are manufactured on an industrial scale.

Their aim is to become the world's best performing and most attractive supplier of low- to high-viscosity nanocarbon dispersions for industrial applications.

Their scope of business focus on those industries using their nano-carbon dispersions to create high-grade composites (super composites) requiring specific mechanical, electrical or thermal features.

**[GXC Coatings](#)** - GXC Coatings in Goslar - in the middle of [Germany](#) - combines the best traditions of Chemistry and Optics which have been part of their shareholders legacy and which were present at their site since the 19th century. At the turn of the millennium, in the Year 2000, these long-lasting experiences led to the foundation of GXC Coatings. Capturing the chances of the rise in nanotechnology, the young company developed the first coating materials for glass surfaces.

Since 2003, GXC pushed developments for polymer surfaces and new areas of application in safety/protection, sensors, displays and optics were added to the existing portfolio. The R&D-department was strengthened and enlarged, customer relations globalised and frequently, new coating materials and millions of coated parts delivered to the market. In 2009, GXC introduced new, lasting solutions for self-cleaning surfaces employed in completely new markets.

**[HielscherUltrasonics](#)** - HielscherUltrasonics is a family owned business, located in Teltow near Berlin. Hielscher's activities are focused on the development and production of ultrasonic devices for use in laboratory and industrial applications. Today, ultrasonic devices

made by HielscherUltrasonics are being used in laboratories and production plants on all continents across the world. HielscherUltrasonics integrates the ultrasonic devices into complex ultrasonic systems, such as wire cleaning systems.

**ItNanovation** - ItNanovation AG, based in Saarbruecken, [Germany](#), is one of the leading nanotechnology companies in the world, developing innovative water filtration systems for large industrial customers.

**JPK Instruments** - JPK Instruments are a leading manufacturer of nano-analytical instruments - particularly based on atomic force microscope (AFM) and optical tweezers systems - for life sciences and soft matter applications. JPK is headquartered in Berlin, and is represented by offices and distributors around the world.

**KleindiekNanotechnik** - KleindiekNanotechnik is a young, customer oriented high-tech company, focusing on developing innovative products in micro- and nano-positioning. Due to miniaturisation in semiconductor technology, optics, micro-mechanics, medicine, gene- and bio-technology, highly precise positioning techniques are becoming increasingly important. Kleindiek products meet and exceed customer's requirements, offering them a new level of precision.

**KlockeNanotechnik** - KlockeNanotechnik have been developing their Nanomotor technology since 1992 - effectively meaning KlockeNanotechnik entered the market even before it existed. Their first microgripper was presented in 1994 - but at that time there was nothing to grip. Now KlockeNanotechnik can benefit from this longtime experience with partners all over the world.

An international network of customers and partnerships in different markets has given KlockeNanotechnik the experience to produce complete systems in short time frames and to meet the particular needs of their customers. This knowledge and the membership in a micro-technology network (IVAM) allows the company to find solutions even for complex problems.

**LayTec** - Founded in 1999, LayTec is the world market leader in the field of in-situ metrology for LED and LASER production. LayTec offers optical and other non-destructive in-situ and in-line metrology solutions for thin film applications.

Since 2008, LayTec has also been marketing its proven expertise for R&D and industrial



applications beyond the semiconductor industry. These advanced in-line metrology solutions are designed and optimized for large-area deposition techniques such as amorphous, polycrystalline and organic thin-films.

**NanoFocus** - NanoFocus AG is a developer, manufacturer, and distributor of measurement technology and software packages for the characterization of technical surfaces. Their products include 2D and 3D scanning profilometers, confocal measurement systems and in-line inspection systems.

**Nanoscape** - is a leading provider of porous, nanocrystalline materials and a developer of tailored application solutions for today's CleanTech markets. Specifically, Nanoscape provides:

- Novel porous materials with nanometre particle size
- Tailored surface modifications and functionalisation
- Ready-to-use dispersions, suspensions and coating formulations
- Encapsulation and triggered-release technology

**Nanoscribe** - Nanoscribe produces laser lithography systems, allowing for the fabrication of true three-dimensional micro- and nanostructures based on two photon polymerization in UV-curable photoresists. Specifically designed IP-photoresists contribute to the unique performance in 3D microfabrication. The underlying technology of Direct Laser Writing (DLW) is a powerful platform for a variety of applications such as micro-optics, photonics, (opto-)electronics, material research as well as life sciences.

**nanotools** - nanotools is located in heart of Munich, [Germany](#). Production began with 3 employees and shared equipment at the Center for NanoScience. nanotools is a high tech precision machining company, making the smallest devices to the very nanometer. They are a supplier to the leading semiconductor manufacturers worldwide, as well as to all industries who require ultra precision components.

**NETZSCH** - The "Grinding & Dispersing" Business Unit of NETZSCH is one of the world's market leaders in wet and dry processing technology, offering an extensive range of products from laboratory to production sized machines and complete plants. A large number of wet and dry grinding systems are available for different grinding tasks down to the nanometer

range, as well as mixers, kneaders or dispersers for low or high-viscosity products for a multitude of applications.

**Omicron NanoTechnology** - Omicron NanoTechnology is the world's leading supplier of analytical instrumentation solutions in nanotechnology research and development. They create innovative instrumentation with state-of-the-art performance and combine analytical tools into sophisticated multi-technique analytical systems using their "multi-technique" philosophy. They support more than 30 different experimental techniques, and for each you will find a number of specialists in their company who can provide support you with project planning, assessment of technique suitability, system design, equipment training, applications support and system upgrades.

**Particular** - Located near Hannover, Particular® produces nanoparticles from almost any solid material, dispersed in water or organic solvents. Using a physical laser ablation process, their nanoparticles achieve a very high purity and surface activity. As of June 2012, Particular's nanomaterial products are distributed through Strem Chemicals.

**Physik Instrumente** - Headquartered in Karlsruhe, with offices around the world, PI manufactures nanopositioning and motion control systems of the highest accuracy. When PI introduced piezoelectric nanopositioning technology almost 40 years ago, typical customers were research labs and universities working on laser cavity tuning, Fabry-Perot interferometers and filters. Few foresaw that whole industrial sectors like semiconductor manufacturing or biotechnology would become dependent on progress in nanopositioning. Today, not even the precision machining industry can do without nanometer-level positioning systems.

**PlasmaChem** - PlasmaChem GmbH. founded 1993 in Mainz, manufacturers nano-materials, detonation, vacuum, plasma and ultra-thin film technologies, and investigates their biomedical and technical applications.

**RETSCH** - RETSCH instruments are used in science and industry for preparing samples for a wide range of different analytical methods, as well as for particle size analysis in the context of production control and quality monitoring. RETSCH's innovative Planetary Ball Mills meet and exceed all requirements for fast and reproducible grinding down to the nano range. They are used for the most demanding tasks, from routine sample processing to colloidal grinding

and advanced materials development.

**[Sentech Instruments](#)** - SENTECH Instruments GmbH develops, manufactures, and sells advanced quality instrumentation for thin film metrology (reflectometer, ellipsometer, spectroscopic ellipsometer), photovoltaics (inline and offline measurement tools), and plasma process technology (plasma etcher, plasma deposition systems, ALD, customized solutions).

**[SüssMicroTec](#)** - With more than 60 years of engineering experience SÜSS MicroTec is a leading supplier of process equipment for microstructuring in the semiconductor industry and related markets. Their portfolio covers a comprehensive range of products and solutions for backend lithography, wafer bonding and photomask processing, complemented by micro-optical components.

**[Sympatec](#)** - Sympatec develops, manufactures and sells a wide range of state of the art instruments for particle size analysis - including laser diffraction, ultrasonic extinction, photon cross correlation spectrometry and image analysis. The primary applications of the Sympatec range of products are pharmaceutical, chemical products, cement, food and beverages, inorganic raw materials, metal and magnetic powders, mineral raw materials, plastics, research and development.

**[WiTec](#)** - Since its' founding in 1997, WiTec has established itself as a market leader in the field of nano-analytical microscope systems (Raman, AFM, SNOM). WiTec's success is based on constantly introducing new technologies and a commitment to maintaining customer satisfaction through high-quality, flexible and innovative products.

## **Nanotechnology Research and Education**

Some of the leading academic institutes in [Germany](#) offering courses and research programs in nanoscience and nanotechnology are listed below:

**[Center for Applied Nanotechnology](#)** - Offers companies and research institutions contract research and development services in the area of nanotechnology. Some of their projects include:

- Development and optimization of nanostructured composite materials for new systems for energy generation and storage.
- Clinical diagnostics of Diabetes – in Vivo Imaging of Beta cell Receptors by Applied NanoTechnology (VIBRANT).

**Ludwig-Maximilians-University** - Promotes nanotech study through the research center given below:

- **Center for Nanoscience** - Promotes and coordinates interdisciplinary research in the field of nanoscience in the Munich area and consolidates research activities at the nanometer scale from the areas of physics, biophysics, chemistry, biochemistry and medicine.

**Jacobs University of Bremen** - Promotes study and research in the field of nanotechnology through the following research center:

- **NANOFUN Research Center for Functional Materials and Nanomolecular Science** - Applies fundamental theoretical and molecular knowledge for the development of functional materials and nanostructures. The research area of functional materials and nanomolecular science extends into diverse disciplines.

**University of Kassel** - Promotes nanotechnology-based study and research through the institutes given below:

- **Institute of Nanostructure Technologies and Analytics** - Works on research and development of optical and opto-electronical devices with micro- and nanostructure technologies with focus on fundamental research that is always application-oriented.
- **Center for Interdisciplinary Nanostructure Science and Technology (CiNSaT)** - Develops nano science activities in collaboration with the departments of mathematics, natural sciences, electrical engineering, computer science, civil engineering, mechanical engineering and philosophy. CiNSaT deals with the synthesis, theoretical analysis, characterization and application of nanostructures.

**Saarland Universities** - Offers an interdisciplinary bachelor's program in Microfabrication and Nanostructures. This program covers fundamental aspects of physics with engineering

sciences and a focus on miniaturization and emphasis on the development of interdisciplinary approach to understanding and using microfabricated and nanostructured systems.

**Karlsruhe Institute of Technology** - The Center for Functional Nanostructures: Conducts research on nanostructures with optical, electronic, biological, and energy storage/conversion functions. The research areas include:

- Nano-Photonics
- Nano-Electronics
- Nano-Biology
- Nano-Energy

**University of Konstanz** - Conducts research in the field of nanotechnology through the research center given below:

- **Collaborative Research Center 767 Controlled Nanosystems** - Aims at studying the interaction of nanostructures with their macroscopic environment and among themselves. Some of their project areas include:

- Structural control of nano-scale model systems
- Optically controlled phonons in nanostructures
- Terahertz quantum optics with semiconductor nanostructures
- Time-dependent transport in correlated electron nanostructures

**University of Hannover** - Conducts research in the field of nanotechnology through the research institute given below:

- **Institute for Solid State Physics** - The institute's Nanostructures Group supports nanotechnology-based research through a number of research facilities such as:

- School for Contacts in Nanosystems
- Center for Quantum Engineering and Space-Time Research
- Laboratory of Nano and Quantum Engineering

**CeNTech** - Provides the infrastructure for direct and interdisciplinary collaborations involving faculties of the University of Münster and conducts research on the development of new

nanotechnology based inventions which can be developed up to the product level.

## Recent Developments

Researchers from the Institute of Polymer Research at Helmholtz-Zentrum Geesthacht (HZG) and the Institute of Material Science at Kiel University (KU) recently published an article on the research study that derived how a membrane with polymer fibers and proteins can be developed into a filter for tiny, non-scaled particles in aqueous solutions. These researches discovered how protein undergoes a change under water. The resultant materials are able to capture all the metal nanoparticles during the filtration process.

BASF, a leading chemical company, has been conducting the Dialog Forum Nano since 2008. This forum aims at promoting transparent communication about nanomaterials. Through this forum BASF aims at establishing itself as a company that not only uses new technologies to develop new products but also a company that provides good communication about these new technologies with representatives from labor unions, research institutes, industry, consumer and environmental organizations and churches.

The 2012 Nanotechnology Conference in Düsseldorf was aimed at encouraging members in Texas and [Germany](#) to improve the market potential for nanotechnology. These new discoveries in the field of nanotechnology and the initiative taken by many companies, educational institutions and research centers to promote the awareness and significance of nanotechnology establish the fact that [Germany](#) is a nanotechnology hub and will continue to be so in the coming years.

[Germany](#) is country that encourages and embraces innovation and technology. They are committed to remaining at the forefront of research as they understand how this helps drive their economy. With the amount of research activity going on in [Germany](#), there is no doubt that developments in nanotechnology will be continue to be forth coming.

In fact at the time of writing this article researchers at the Fraunhofer Institute for Production Technology had just announced their intention to spearhead a research program ensuring that manufacture of microfluidic systems and lab-on-a-chip technologies can be performed

cost effectively. These systems have enormous potential for the rapid and simple analysis of biological and chemical samples.

Also just a few weeks prior to that, Nanoscribe launched the world's fastest 3D printer for creation of nanostructures. These two examples show that the nanotech industry in [Germany](#) is thriving with commercial applications in mind.

Read the [original article](#) on Azonano.