Center for Applied Nanotechnology

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EU Takes on Diabetes

CAN GmbH Heads International Partner Consortium

"VIBRANT" stands for "In Vivo Imaging of Beta cell Receptors by Applied Nano Technology" and is the title of a successful joint project initiated by CAN GmbH dealing with medical imaging of the so-called "beta cells" of the human pancreas. These cells, which regulate the blood sugar level by releasing insulin, are present only in small amounts. When they die, humans develop diabetes. So far it has been impossible to measure them quantitatively in the living organism. The aim of the proposed project is to develop a method for quantitative determination of beta-cell mass. This would permit early diagnosis of this disease of civilization, which has serious consequences for the health and social well-being of those affected and ultimately immense costs for national economies – due to late complications of diabetes like blindness, kidney failure and amputations.

At the beginning of 2008, eight well-known research institutes from Germany, Belgium, Spain, Denmark and Sweden, as well as two German companies applied for the research mandate under the leadership of CAN GmbH. "As the originator and applicant, CAN is responsible for coordination of the research work – as well as naturally the development of the required, highly complex nanoparticles," explained CAN Business Development Expert and Project Leader Dr. Theo Schotten. VIBRANT was one of thirty EU-funded major projects selected in a two-phase review process. The scientific quality and benefit for society were assessed by the reviewers as excellent. "The next step for us will be to conduct detailed negotiations for the project in Brussels with Commission representatives and coordinate conclusion of a consortium agreement among all partners," said CAN Chief Operating Officer Dr. Frank Schröder-Oeynhausen, who is excited about CAN GmbH achieving another milestone. VIBRANT is scheduled to run from the beginning of 2009 to the end of 2012, with a total volume of approx. Euro 10 million. Leading pharmaceutical companies have already expressed interest in the results expected from this research.

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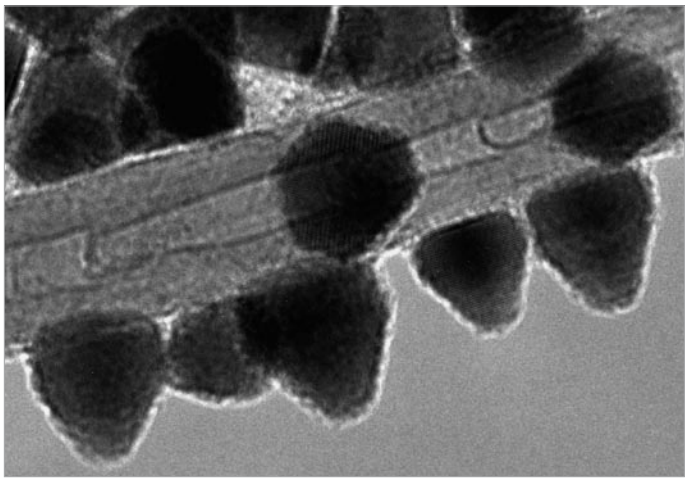
BMBF Project SONAPOLY Approved

On the 1st of September the BMBF joint project "SONAPOLY" for developing hybrid solar cells based on functionalized nanostructures and conductive polymers was approved. The aim of the project is to develop innovative, powerful inorganic/organic solar cells based on different nanoscale functional units. "CAN GmbH, which is coordinating this project with five well-known partners, is responsible for development of the polymer design and construction of the prototype," explained CAN Project Leader Dr. Christoph Gimmler.



Dragontails: CdSe nanoparticles assembled on Carbonnanotubes

The goal is to construct hybrid cells made of semiconductor nanostructures (e.g. CdSe or CdTe nanoparticles) that can be used as photostable, broadband absorbers with a high absorption coefficient for effective utilization of the solar spectral range. After the incident light is absorbed and converted to charge carriers, an innovative coating structure is used for efficient and rapid separation of free charge carriers: The holes generated are transferred to an organic polymer matrix, while the electrons are conducted through oriented carbon nanotubes. Therefore this concept combines the advantages of a semiconductor nanostructure as the "collecting material" with the excellent transport properties of carbon nanotubes. The concept is associated with a high scientific-technical risk but also offers high application potential because a number of the disadvantages of previous concepts such as narrowband absorption or low photostability have already been eliminated in the new concept. SONAPOLY has a total project volume of nearly Euro 2 million.

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Feasibility Study on Decontamination of Surfaces by Photocatalysis

As part of a current feasibility study, CAN is investigating the photocatalytic properties of titanium dioxide surfaces and improving their properties by modification of the applied coatings. Such coating systems to degrade biologically active substances find use, for example, on the inside walls of medical facilities like operating theatres. Used as the light source in this study are standard fluorescent lamps. These lamps have a strong emission line at 405 nm in the wavelength range from approx. 380 nm to 420 nm that can be used to activate surfaces coated with titanium dioxide. "Doping with gold nanoparticles should make the photocatalytic activity of

TiO2 more efficient in eliminating contamination from DNA fragments," explained CAN Project Leader Dr. Christoph Gimmler. "We also plan to modify the surface of titanium dioxide nanoparticles after synthesis in order to place different anchoring groups on their surface. Particles modified in this way should adhere better to a polymer surface that is also modified and show improved film forming properties."

If the substrate to be coated is plastic, it must first be protected against the photocatalytic effect of titanium dioxide. An effective protective or buffer coating can be achieved with silane or silicate chemistry. At the same time the goal is to improve binding of the titanium dioxide nanoparticles to the substrate through a corresponding surface modification of the SiO2 transition coating and its inorganic properties. This improved binding would have beneficial effects on the mechanical stability of a photocatalytic titanium dioxide coating. To evaluate the efficacy of the photocatalytic TiO2 coating, a degradation reaction with a certain DNA fragment will be defined and examined in reproducible experiments. This will allow direct comparison of coating systems derived from different synthesis and coating systems.

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Biocompatibility of Nanoparticles

Whether nanoparticles have a harmful influence on their environment is an important question currently under intense discussion. To answer this complex question it is necessary to determine systematically the influence of every possible variation of nanoparticles on human cells.
In a project funded by the Hamburg Innovation Foundation, CAN GmbH has been working on just such a systematic analysis since 2006 with the aim of determining what properties of nanoparticles negatively affect cell physiology (1) and how intelligent particle design can prevent these unwanted effects (2). "In this project we systematically alter specific parameters of nanoparticles like their size, shape or shell. After two years of work we now have a set of nanoparticles available that we can use to influence specific properties of the particles," said Dr. Thomas Frahm, the responsible Project Leader. The nanoparticles of this set are precisely characterized in the CAN laboratories by combining them with cultivated cells and monitoring them for toxic and cell physiological effects. "With our fluorescent particles, the CANdots, we can see exactly where the particles end up in cells. This gives us important feedback," added Dr. Frahm.
All data are collected in a database that allows the CAN staff to do a combined analysis of several experiments and evaluate potential toxicity of nanoparticles by comparison of data. "We already have a fairly precise idea of what a toxic or, more importantly, a non-toxic nanoparticle should look like," said Dr. Frahm. "This is why the service we offer in this project starts with advising, continues with synthesis and ends with a complex biological evaluation." In future projects CAN GmbH will continue to study – in even more detail – the biological effects of nanoparticles in order to create safe basic conditions for their use in life sciences.

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Science and Research Up Close in Hamburg

This year CAN GmbH is one of 16 Hamburg initiatives in the "365 Landmarks in the Land of Ideas 2008" event series. On the 4th of December the CAN GmbH Team will hold a day long "Open House" for the interested public. Visitors will have the opportunity throughout the day to watch us as we work. We will be giving lab tours in small groups and show how gold nanoparticles are produced, what nanoparticles can do as surface coatings, where nanoparticles are used in medical technology, how nanoparticles are made visible to the human eye, and much more.

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Lab tours are scheduled at the following times:

11:15 a.m.: Electronen microscopy
1:15 p.m.: Nano medical technology
3:15 p.m.: Nanochemistry

At 5 p.m. Prof. Horst Weller will make the world of nanotechnology come alive in an experiment-packed lecture. Throughout the day you will have the opportunity to ask our staff questions about nanotechnology and in a small exhibition you can find out about the results of the work we have done so far.

We are looking forward to welcoming you! If you are interested in one of the tours please register at www.can-hamburg.de or send us an email at: gsm@can-hamburg.de

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CAN GmbH Partners

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CAN GmbH offers companies and research institutions contract research and development services in the area of nanotechnology and participates in national and international research programs. The focus of activities is on the utilization of new findings made in chemical nanotechnology and nanoanalysis, particularly in the areas of consumables, special polymers and health care. The main areas of expertise include, in addition to the characterization of nanostructures, the production of numerous nanoparticulate and nanocomposite materials, the encapsulation of active substances as well as the development of nanoparticle-based biological and medical markers.

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