NINa-News
North German Initiative Nanotechnology SH
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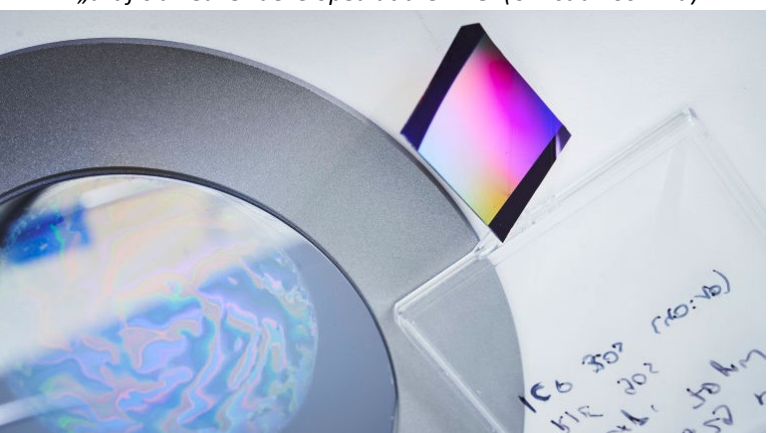
Dear Reader,

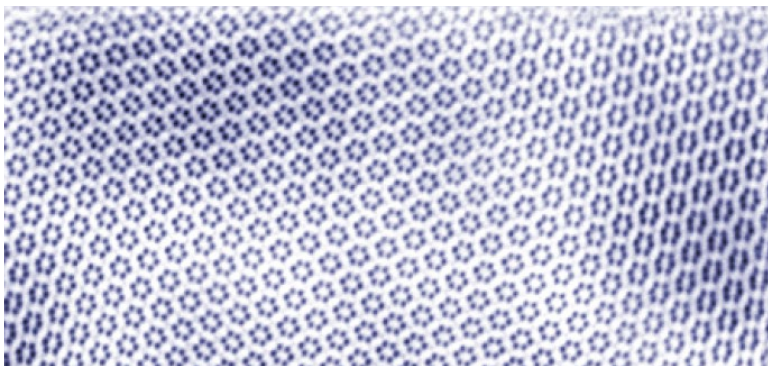
Prof. Dr. Thomas Klassen

The climate change represents one of the greatest challenges of mankind today. The upcoming decade will be decisive for the transformation towards more sustainable technologies. Nanostructured materials offer effective solutions for many areas of our life. Nanotechnology is indispensable especially for a sustainable energy supply in the future.

Several universities and institutes in Northern Germany work on solutions for the storage of wind energy either directly in the newest generation of batteries or as hydrogen. In batteries, nanocrystalline ionic conductors and nanostructured electrodes enable a faster transport of charge. This in turn is the very basis for more powerful batteries. For the storage of energy in the form of hydrogen nanocrystalline metal hydrides are the materials of choice. Their nanostructure allows the rapid absorption of hydrogen, a safe long-term storage and a very quick release when needed. Metal hydrides can store the same amount of energy in the fifth of the weight of modern lithium-ion batteries. In addition, metal hydrides posses up to twice as much capacity compared to the storage of hydrogen in the liquid state or as a compressed gas. Due to these advantages metal hydrides yield enormous potential for stationary and mobile energy storage solutions.

An „artificial leave“ developed at the HZG. (Christian Schmid)





Atomic resolution image of hydrogen-storing metal hydrides. (HZG/Div. Metal Physics)

Thyssenkrupp Marine Systems in Kiel already uses metal hydrides in submarines. Volkswagen investigates metal hydrides together with the Helmholtz-Zentrum Geesthacht for the application in emission-free electric cars. Furthermore, researchers of the Helmholtz-Zentrum Geesthacht study nanostructured surfaces for the direct conversion of solar energy into hydrogen. These cells can not only dissolve water into its elements but they also enable the reaction of CO_2 with water to carbohydrates. By this means these “artificial leaves” could help in the future to reduce CO_2 in the atmosphere.

Nanotechnology offers solutions for the transformation of today’s society toward more sustainability and even for the regeneration of our ecosphere. We have to consequently implement these solutions in the years to come to preserve our living environment.

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Schleswig-Holstein. Der echte Norden.

Innovative shipbuilding thanks to nanotechnology

Unwanted by-catch is in times of ever dwindling resources a financial and an ecological problem. During the parliamentary evening of nanotechnology in Berlin, Dr. Zahlmann-Nowitzki from thyssenkrupp Marine Systems explained how nanotechnology can help to solve even this problem and enable many more innovations in shipbuilding.

The future mission of the mini submarine oXeanseeker is to reduce by-catch by identifying the kinds of fish in a shoal. However, many components have to be optimized by nanotechnology to make the vessel for example corrosion-proof, scratch- and shock-resistant and fouling-repellent. “Technical innovations in single components are necessary to advance the complex total system in shipbuilding,” says Dr. Zahlmann-Nowitzki from thyssenkrupp Marine Systems in Kiel, Germany.

Nanotechnology plays a crucial role in the advancement of propulsion systems of large submarines as well, for example to increase the efficiency of fuel cells or to improve air filtering systems. While today the hydrogen in fuel cells is stored in metal hydrides, more efficient storage media will have a smaller weight and volume in future. This in turn will improve the vessel as a total system.

Thyssenkrupp Marine Systems posses a major advantage in the city of Kiel. On the opposite site of the street scientists from the Technical Faculty of Kiel University develop lithium-ion batteries based on silicon (see article below). “Co-operations are a crucial factor for the innovative power of a company. To have a trustworthy R&D partner in close proximity is a great advantage,” explains Dr. Zahlmann-Nowitzki. Hence the shipbuilding of the future, too, profits from the varied nanotechnological competencies in the state of Schleswig-Holstein.

©thyssenkrupp MS

Naming ceremony of the newest submarine of the 218SG class. The multi-hybrid propulsion technology allows underwater traveling for several weeks.

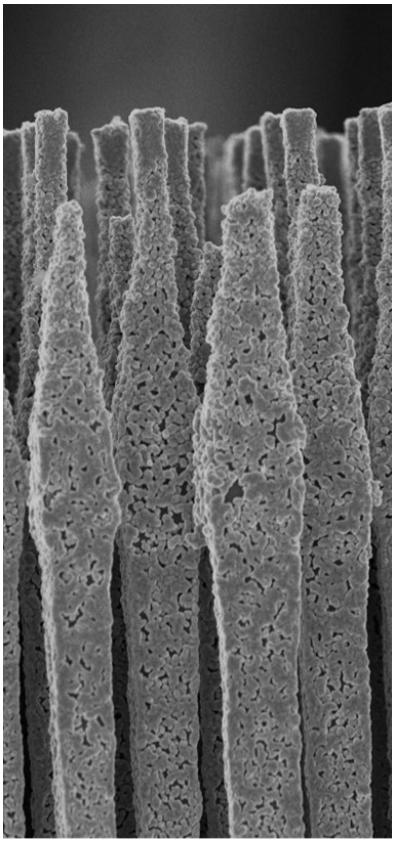
Energy storage of the future

For years silicon has been the material of choice for microtechnology and has been used for example in microchips and sensors. However, the potential of the material still has not been realized in the important future field of renewable energy and energy storage.

“Silicon is theoretically the best material for anodes in rechargeable batteries. It can store up to the tenfold amount of energy compared to anodes made of graphite in state-of-the-art batteries,” says Dr. Sandra Hansen from the Technical Faculty of Kiel University. However, silicon expands and shrinks by 400 per cent when it gets charged and discharged with lithium ions. This expansion is challenging as it leads to mechanical instability which destroys the battery within a few loading cycles.

For years, scientists of Kiel University have developed an optimal geometry for an electrode made only of silicon. They achieved a breakthrough with a parallel arrangement of well defined individual silicon wires. One side of the micrometer-sized wires is embedded in copper so that the mechanical contact cannot degrade during the charging cycle. Tests proofed the first generation of battery cells to be stable during more than 500 charging cycles. Additional advantages of the new battery structure are a short charging time and increased safety.

At present a second generation of silicon electrodes is developed together with the company RENA Technologies in order to transfer the technology from fundamental research to industrial application. “Thanks to the co-operation we are able to transfer findings rapidly from university science to industrial application. This is real innovation transfer!” says Professor Rainer Adelung, who is in charge of the working group Functional Nanomaterials at Kiel University.



©CAU/S. Hansen

The innovative geometry of the silicon cells improves their mechanical stability.

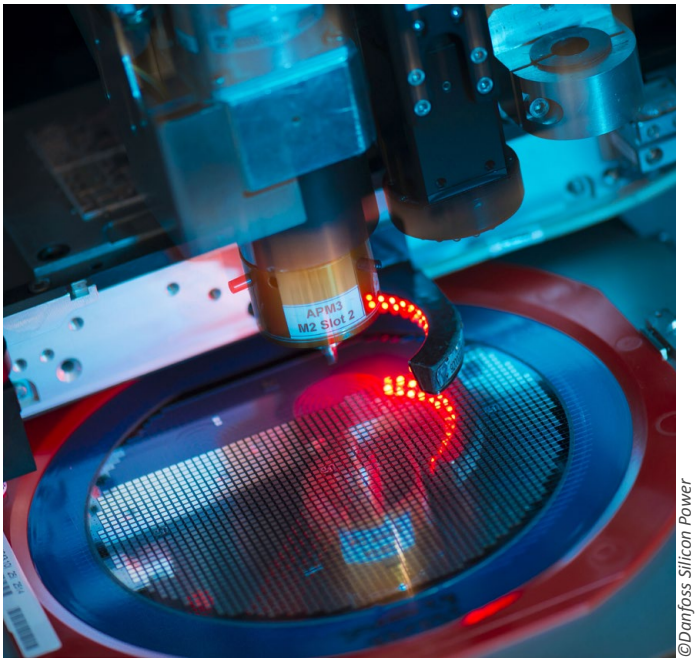
At peak power

For over three decades Danfoss Silicon Power GmbH has developed and produced power modules for applications in industry, electro-mobility and renewable energies. Nowadays nanotechnology has become essential for the devices.

The importance of nanotechnology in power electronics has grown steadily as the necessary miniaturization leads to ever increasing power in shrinking volume. To stay on top of this industry-wide trend Danfoss Silicon Power focuses on innovative nanomaterials, latest nanotechnological developments and a strong network of R&D partners.

Nanotechnology is employed manifold in the products of Danfoss, for example in the encapsulation of power modules. Furthermore, the mechanical properties of epoxy resin molded parts for the automobile industry are optimized by addition of nanomaterials to cope with the harsh operating conditions.

Danfoss Silicon Power GmbH currently employ 500 staff with headquarters in Flensburg, Germany. It's clean room comprises more than 3900 sqm for the mass production of power modules. The company is the worldwide largest independent manufacturer of customized power modules.



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A silicon wafer during the fabrication process.

Tailored microanalytics made in Kiel

©myStandards

Revolutionary solid mater analytics - this is the motto of myStandards GmbH from Kiel. The company produces compacted nanoparticulate pellets for chemical microanalysis.

Microanalytical techniques for the analysis of solid mater have improved tremendously in recent years and a wide variety of highly capable instruments were introduced. However, reference samples need to be sufficiently homogeneous to validate the microanalytical results in accordance with ISO. So far, the preparation of suitable reference materials was challenging and a problem for solid mater analysis.

The start-up myStandards solved this problem with their "Nanopellets" made of minerals and rocks. They created a patented manufacturing process which is able to produce finest powder of various geological materials and press them to pellets.

The particular advantage of the method is the size of the resulting particles of below one micrometer. This leads to a homogeneous distribution of all chemical components throughout the whole sample. The fine powder also allows the compacting of the pellet without any binding agent. The process yields ultra-homogeneous and ultra-pure reference materials which are used for example in climate research or by the mining industry.

Rocks can now simply be analyzed in-situ with a laser instead of conducting a complex acid hydrolysis. The results can even be interpreted quantitatively thanks to the reference samples.

The founders of the company, Christina Wittke and Simon Nordstad, see another advantage of the universal technique - it allows the manufacturing of individually tailored reference materials. Mrs Wittke and Mr Nordstad founded the company in October 2018 after completing an Exist-project. They currently establish an own laboratory in Kiel's innovation and technology center.

Connecting the Baltic Sea Region

International co-operations will in future become ever more important to effectively make use of the tremendous potential of nanotechnology. NINa SH offers a central networking stage with the annual conference "Nanotechnology and Innovation in the Baltic Sea Region" (NIBS).

The third issue of the NIBS conference took place in Poznan (Poland) in June together with the conference NanoTech Poland 2019.

Dr. Christian Ohrt, coordinator of the conference and managing director of NINa SH, draws a positive balance, "We reached our goal for the conference with over 150 attendees and an intensive exchange on international level." NINa SH continuously extends its network into the Baltic Sea region, which already reaches into Denmark, Sweden, Lithuania, Latvia and Poland. The added value of this international exchange was demonstrated for example by Dr. Mindaugas Bulota from the Kaunas University of Technology. He impressed the audience with best practice examples of how to efficiently transfer technology from fundamental science to industry.

The joint symposium of NIBS and NanoTech Poland 2019.

The fourth NIBS conference will take place in Germany in the city of Hamburg in June 2020. Further information will be posted timely on the website of NINa SH.

NINa's Highlights

On this page, NINa SH presents recent highlights from the field of nanotechnology and news from science and industry. You can inform the network about your activities here, too - send us your highlight.

NanoWorkshop 2019 in Helsinki

The NanoWorkshop of the Aalto University in Finland has a long tradition. The ninth workshop will take place from July 22nd to 24th at the Aalto University in Helsinki. International experts will report on the latest research from the field of polymer-metal nanocomposites. For the first time, the workshop will be followed by a summer school which is devoted to the production, characterization and application of metal-polymer nanocomposites.

Conference-School "Advanced Materials" in Lithuania

The 21st conference-school "Advanced Materials and Technologies" in Palanga (Lithuania) for young researchers and PhD-students addresses different material systems and their applications. Topics include biophotonics, plasmonics, characterization of nanomaterials, metal-oxide ferrimagnets and more. The event is organized by the Kaunas University of Technology and further institutions from Lithuania, Latvia, Estonia and Denmark.

3D-printing of nanomaterials in medical engineering

The scarcity of donor organs is a societal problem. Artificially manufactured organs would be a medical breakthrough. Israeli scientists demonstrated recently that whole organs might be 3D-printed with body's own cells in future. In line with this trend, the German Federal Ministry of Education and Research launched the innovation contest "Organ Replacement from the Laboratory".

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