INASCON 2018

INTERNATIONAL NANOSCIENCE STUDENT CONFERENCE

7th to 10th of August 2018

INASCON 2018 Conference Booklet

inascon_official   https://inascon.org   INASCON   contact@inascon.org

A few words from the INASCON 2018 leaders

Dear INASCON 2018 participant,

We would like to welcome you all to beautiful Trondheim, Norway, for the 12th annual International Nanoscience Student Conference. For over a decade, students all over Europe have put down an impressive effort to make such a fantastic event, connecting students with a passion for nanotechnology from all over the world. This conference is organized by students, for students, and we are incredibly proud of the commitment from both the participants, and of course the organising committee.

The next days will be among 2018's busiest. The days are packed with a tight schedule consisting of invited speakers from seven different countries, exciting PhD-presentations, workshops, and a fantastic social programme with gala dinners and trips to Trondheim's most beautiful sites. The academic programme is diverse, demonstrating how multidisciplinary nanoscience truly is. The beauty of INASCON is that experts in all fields are gathered, and perhaps the next big idea comes from Trondheim this week.

This is the first time the conference is arranged in Norway, and it is held at NTNU, Norway's biggest university, and the university in Norway with the biggest focus on science and technology. The students of nanotechnology at NTNU are few in numbers, but considered to be among the most eager in Norway. The efforts laid down to organize INASCON 2018 definitely supports this theory. Students from all five year groups of the integrated masters degree in nanotechnology have contributed to the conference, and we are indescribably proud of all the work that has been put down.

Plenty of work has also been done stretching beyond the boundaries of the conference. Together with Trondheim municipality, a summer science camp focusing on n anotechnology has been established. New industries and projects have found a big interest in nanotechnology thanks to the promotion of the conference, and we have shown to Norway that nanotechnology is indeed a field to look out for in the years to come. We would like to thank all members of the organising committee for their tremendous work put down. However, the conference would not be possible without the support of NTNU Nano with the coordinators Hanna Gautun, Kay Gastinger and John de Mello. Thank you to you all.

Now, dear delegate, remember that this conference is for you. Please enjoy every moment, and remember that we are there to help you. We wish you a fun, inspiring and unforgettable experience!

On behalf of the INASCON 2018 organising committee,
The INASCON 2018 Leaders,
Simen Ringdahl, Nicolai Winter-Hjelm and Anders Strømberg

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18:00 - Dinner at Lian

WEDNESDAY

08:30 - Invited speaker: *Iain McCulloch*
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09:45 - Coffee break and company exhibition
10:15 - Panel discussion
11:15 - Workshop: *Pitching crash course: Explaining your research to gramma*
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13:00 - Invited speaker: *Nils Wagner*
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INTERNATIONAL NANOSCIENCE STUDENT CONFERENCE
PROGRAMME

THURSDAY

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FRIDAY

09:00- Workshop: *Nanotechnology as Solution*
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11:15 - Coffee break
11:30 - Invited speaker: *Sofie Snipstad*
12:15 - Lunch
13:00 - Closing ceremony

Trondheim

Modern city with a millennia of history

Trondheim, formerly the city of kings and capital of Norway, now urban and vibrating, packed with restaurants, landmarks and a vivid nightlife. Additionally, it boasts a beautiful scenery on sunny days, due to its fjord and the surrounding hills, making nature prevalent in the city.

Trondheim is strategically situated in the fjord of Trondheim, below the hills of Bymarka, and protected by the river Nidelven. This gives the city access to both inland Norway and the sea, while keeping the ocean's fury at a comfortable distance. The viking Leiv Eriksson set sail from Trondheim, in a journey that eventually reached Newfoundland, making him the first European to set foot on the North American continent. A statue of him gazing out at the sea can be found at the pier. Other places worth checking out are the city's cathedral Nidarosdomen, the Old Town Bridge, the red Student Society (Samfundet), and the Tyholt Tower, amongst others. The city is true to its roots, which will be apparent once entering the city centre.

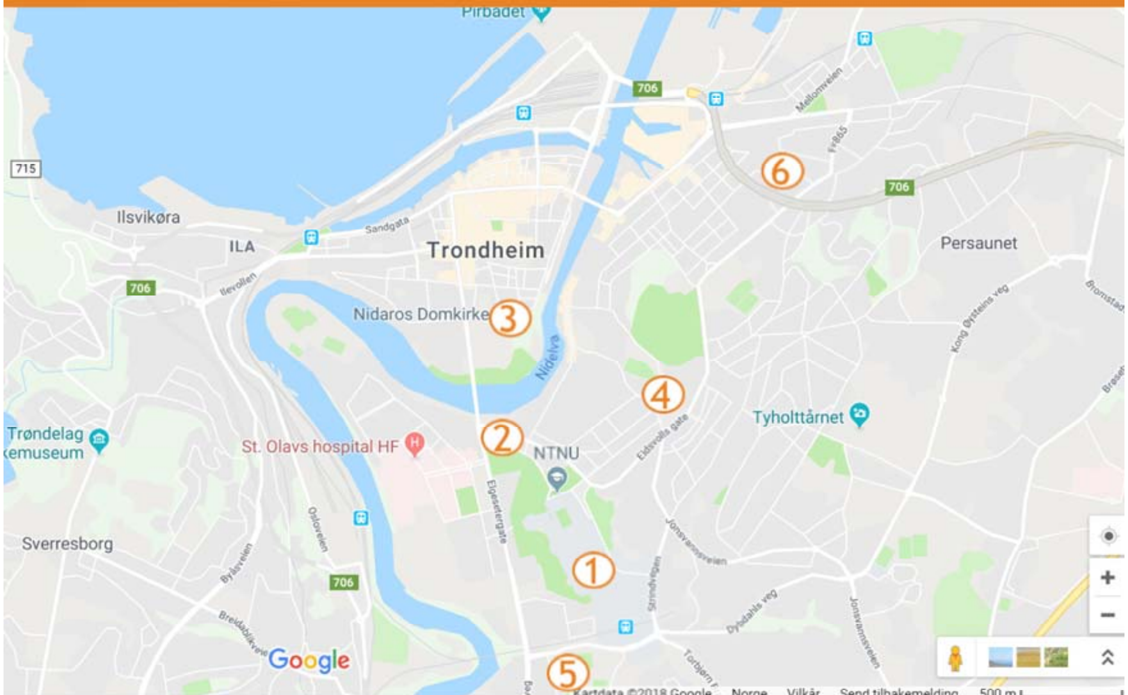
When walking around in downtown Trondheim, the cozy architecture will leave you with a feel of tradition and authenticity - that many other modern cities might lack. Most buildings are only a couple of floors high, and often covered in a colorful wooden facade - the historically prefered material. This style is especially apparent at the banks of the river - the city's old commercial heart - and in the borough of Bakklandet. The calm and beautiful streets of Bakklandet gives a refreshing break from day to day life. Pop into one of the many pubs or coffeehouses located there, and pay a visit to the Old Town Bridge when you're in the area. If you're feeling ready for a stroll, walk up the hill to Kristiansten Fortress to get a beautiful view of the city.

The towers of the proud cathedral Nidarosdomen is visible almost throughout town. The cathedral is a national treasure. It's the oldest cathedral in Norway, and the northernmost in Europe. Since Norway's birth as an independent nation in 1905, the Norwegian monarch has been inaugurated here by the Church. Construction started in the 11th century, above the grave of King Olav the Holy. King Olav contributed to the christening of Norway, which strengthened the state, and allowed it influence on the christian European continent. The cathedral is open for visitors for a fee, and it's possible to join a guided tour. A visit is well worth it, as the cathedral is a marvel of gothic architecture, and gives an unique insight into Norwegian history and culture.

For this year's conference, the most important landmark in Trondheim is inevitably Gløshaugen campus. Here, old and new blend together. Closest to the city center lies the oldest buildings, where the dominant Main Building overseas downtown Trondheim. You can get a pretty good view of Trondheim from here. The buildings in this part of the campus were constructed from 1905 to 1910, when the university was opened. They have monumental facades that consist of solid stone bricks. Further back lies newer buildings, built as the university expanded. The architecture here is more modern, and the buildings uses more steel and glass. Both NanoLab and the research organization SINTEF are located at campus.

Photo: WikiStrinda

Map of Trondheim and important sites



1 - Realfagsbygget Gløshaugen Campus
Most of the conference will take place here.

2 - Student Society (Studentersamfundet)
The banquet at thursday evening will be held here.

3 - Nidarosdomen
The concert at wednesday evening will be held in this cathedral

4 - Singsaker Summer Hotel

5 - Scandic Hotel Lerkendal

6 - Trondheim Vandrerhjem (Hostel)

Transportation

The best way for travelers to get around in Trondheim is by bus or walking. Singsaker Summer Hotel, Scandic Hotel Lerkendal and other hotels in the city centre are all in walking distance from the conference venue.

If you want to get around by bus, you will find bus stops served by the local bus service, AtB, all over town. Information about tickets and fares, as well as bus schedules, can be found at their website: https://www.atb.no/en/. It is possible to buy tickets using your phone, either by use of the "AtB Mobillett" app, or by sending a message that says "Voksen" to +47 2027.

Transportation to the conference venue

Singsaker Summer Hotel is about a 15-minute walk from the conference venue. If you want to travel by bus, the nearest bus stop is Jonsvannsveien. To get to the conference venue you can travel with bus 63 from Jonsvannsveien to Høgskoleringen, and then bus 5 from Høgskoleringen to Gløshaugen Syd.

For the participants staying at Scandic Hotel Lerkendal, the conference venue will be in a 10-minute walking distance. The nearest bus stop from this hotel is Lerkendal stadion. Other bus stops nearby are Lerkendal gård and Professor Brochs gate. The closest bus stop to Trondheim Vandrerhjem is Weidemannsveien. To get to the conference venue from this hostel you can take bus 63 from Weidemannsveien to Høgskoleringen, and then take bus 5 to Gløshaugen Syd (15 minutes), or walk (30 minutes).

Getting around at the venue

The conference will be held at NTNU Gløshaugen Campus in the building named Realfagbygget. A map over Gløshaugen can be found by opening https://www.use.mazemap.com/ in a browser, or downloading the app MazeMap. Choose location NTNU > NTNU i Trondheim > Gløshaugen. Most of the lectures will be held in the auditoriums R1 and R2.

Speakers in order of apperance


Sir James Fraser Stoddart


Iain McCulloch


Nils Wagner


Sol Jacobsen


John De Mello


Peter Bøggild


Ursula Gibson


Kurt Wüthrich


Sofie Snipstad

Sir James Fraser Stoddart

tuesday 15:00

Sir Fraser Stoddart is one of the most cited chemists world-wide. He has won countless awards and honors, among them the 2016 Nobel Prize in Chemistry and the 2007 Feynman Prize in Nanotechnology. In 2006 he was appointed Knight Bachelor by Queen Elizabeth II. He is currently professor of chemistry at Northwestern University.

Fraser Stoddart was born in Edinburgh in 1942. In 1960 he went to Edinburgh University where he graduated in 1964 with a BSc degree. He stayed at the chemistry department at the University of Edinburgh until 1967, when he received his PhD. He has since been living in Canada, the UK and USA.

Stoddart is famous for his contributions to self-assembly molecular processes and molecular machines. Upon winning the Davy Medal in 2008, the Royal Society stated that "His work bridges the gap between chemistry and the scientific and engineering challenges of nanoelectromechanical systems."

Fraser is a Fellow of the Royal Society of London, the German Academy of Natural Sciences, and the Royal Netherlands Academy of Arts and Sciences, as well as an Honorary Fellow of the Royal Society of Edinburgh and the Royal Society of Chemistry. He is a Member of the American Academy of Arts and Sciences, the National Academy of Sciences, and the European Academy of Sciences. He is a Foreign Member of the Chinese Academy of Sciences.
Fraser Stoddart's late wife, Norma, was also a chemist, and both of their daughters, Fiona and Alison, are PhD chemists!

Iain McCulloch

Wednesday 8:30

Iain McCulloch is professor of polymer materials at King Abdullah University of Science and Technology. He also holds a chair at the department of chemistry at Imperial College. He researches high performance organic semiconductors for use in photovoltaic devices and field effect transistors.

Iain McCulloch received his Ph.D. in polymer chemistry at Strathclyde University in 1989. He then moved away from academia for a while, heading industrial research groups in Hoechst and Merck. While working in the industry, he researched a design of functional polymers for optical, electronic, photovoltaic and bioelectronic applications. In 2007 McCulloch then became a professor at Imperial College. Since then he has, among other things, developed design strategies for electron-accepting semiconductor molecules for use in organic solar cells. His work has led McCulloch to become a widely recognised researcher. According to 2011 Thomson Reuters data, he is the UK's 2nd most cited material chemist.

Talk abstract: Low Conformational Disorder Semiconducting Polymers for Organic Electronic Applications

Synthesis of conjugated aromatic polymers typically involves carbon coupling polymerisations utilising transition metal catalysts and metal containing monomers. This polymerisation chemistry creates polymers where the aromatic repeat units are linked by single carbon-carbon bonds along the backbone. In order to reduce potential conformational, and subsequently energetic, disorder due to rotation around these single bonds, an aldol condensation reaction was explored, in which a bisisatin monomer reacts with a bisoxindole monomer to create an isoindigo repeat unit that is fully fused along the polymer backbone. This aldol polymerization requires neither metal containing monomers or transition-metal catalysts, opening up new synthetic possibilities for conjugated aromatic polymer design, particularly where both monomers are electron deficient. The condensation reaction locks the repeat units together with a carbon-carbon double bond link, eliminating free rotation of the repeat units and thus rigidifying the polymer conformation. Polymers with very large electron affinities can be synthesised by this method, resulting in air stable electron transport, demonstrated in solution processed organic thin film transistors. The rigid, planar nature of the backbone also facilitates extended delocalisation of both frontier molecular orbitals and a subsequently low bandgap. We present an electrical, optical and morphology characterisation of polymer thin films, illustrating structure-property relationships for this new class of polymers.

Nils Peter Wagner

Wednesday 13:00

Nils Peter Wagner is a Postdoctoral Fellow at the Department of Materials Science and Engineering at NTNU. His work concerns, amongst others, silicon anodes and the improvement of Li-ion batteries.

Wagner's publications mostly focuses on research of different anode and cathode materials in Li-ion batteries, and methods of synthesizing such materials. For instance, by flame spray pyrolysis or sol-gel synthesis. In addition, he commits research on different ways to synthesise anode and cathode materials by taking advantage of leftovers from other reactions.

Wagner is currently employed as a researcher at SINTEF, located at the NTNU campus.

Talk abstract: Nanotechnology in Li-ion batteries: Possibilities and liminations

Research concerning Lithium based batteries started in the 1970s and rechargeable rocking chair type Li-ion batteries were commercialised in the early 1990s. As of today, Li-ion based chemistries are on the forefront of battery technology with respect to performance, cycling stability, self-discharge and expected lifetime. Numerous alternative electrode materials have been examined during the last decades, with the aim to increase the energy density, lifetime and safety of Li-ion batteries. Most of those materials come with challenges that might be addressed by reducing the particle dimensions, or the application of nanoscale coatings. This presentation will give a comprehensive description of Li-ion batteries in general and point out examples were nanotechnology could be employed to overcome material shortcomings. It also discusses limitations were nanotechnology might be interesting from a scientific point of view, but cannot be sought as a solution for commercial batteries. Examples included in this presentation are polyanion based cathode materials such as olivine-structured phosphates and transition metal orthosilicates. These materials suffer from low ionic and electronic conductivity values compared with oxide base cathode materials. Furthermore, focus will be given to silicon as alloying anode that could potentially replace the graphitic anode found in most commercial Li-ion batteries.

Sol Jacobsen

Wednesday 14:45

Sol H. Jacobsen is a Post-doctoral researcher at the institute for physics at the Norwegian University of science and Technology. She got her PhD in theoretical physics under the supervision of Associate Professor Peter Jarvis at University of Tasmania in Australia, and she also possess a joint honors degree in physics and philosophy from University of York, UK.

She is currently working at the NTNU Center for Quantum Spintronics (QuSpin), more specifically with theory for superconductive and ferromagnetic hybrids. Her research interest is mainly fundamental quantum physics, but she also has a background in basic quantum theory, integrated systems and quantum optics.

Talk abstract: Low-dissipation Spintronics: The information technology future

The digital age is defined by the pervasive impact of information technology, where rapid data processing now underpins nearly every societal institution. The relentless pursuit of greater efficacy led to the revolutionary harnessing of quantum spin within electronic architectures. These new spintronic devices that use both charge and spin are now widely adopted commercially in applications such as hard drives and random access memory. Despite the landmark change in approach, the efficiency of such spintronic circuits based on electron transport is still severely restricted by Joule heating and short decay lengths. This has spurred an international race to engineer conceptually new approaches that will enable low-dissipation spintronics to power energy efficient big data processing. The researchers at the NTNU QuSpin Center of Excellence are taking a lead role in this pursuit, and this presentation will give some insight into the challenges and progress made at the frontier of low-dissipation spintronics.

John De Mello

Wednesday 16:30

John de Mello is a Professor of Nanomaterials in the Department of Chemistry at Imperial College London and Scientific Director of NTNU Nano. He researches nanomaterials for use in electronic devices and sensors. John obtained his Ph.D. in semiconductor physics from Cambridge University. In 2002, he co-founded Molecular Vision Ltd - a company specialising in the use of organic LEDs and photodiodes for chemical sensing. He has been awarded both a Royal Society Industry Fellowship and the Brian Mercer Award for Innovation in Nanotechnology. His research interests include flow chemistry, organic semiconductors, quantum dots, light-emitting diodes, solar cells and sensors. He is on the editorial boards of the Journal of Experimental Nanoscience and the Journal of Organic Semiconductors.

Peter Bøggild

Thursday 08:30

Peter Bøggild is a professor at the Department of Micro- and Nanotechnology at Technical University of Denmark.

He is currently working on several projects revolving around the use of graphene, more specifically the development of ballistic graphene. This is graphene which can act as a medium where electrons may be transported having negligible resistivity. Bøggild is working on finding the theoretical transport properties of ballistic graphene devices, finding graphene devices that would work in room temperature, as well as investigating its possible uses. If all this work succeeds it will have a great impact on the efficiency of future electronic devices.

Talk abstract: 2D materials and the new ”magic” nobs

Ursula Gibson

Thursday 11:00

Ursula Gibson is professor of physics at the Norwegian University of Science and Technology. She is currently doing research on the development of optical materials, using nanotechnology.

Ursula Gibson received her Ph.D. in physics from Cornell University in 1982. She has been an associate professor at the Optical Sciences Center at the University of Arizona and at Thayer School of Engineering at Dartmouth. She has also held several visiting positions, including the United States Air Force Academy, NASA's Marshall Space Flight Center, Tampere University of Technology in Finland, Chalmers University in Sweden and the University of Queensland in Australia. Gibson was awarded the Fulbright Scholarship in 2008 to fund research on "Nanostructured ZnO for Wood Preservation". In 2017, she was elected to be the 2019 president of the Optical Society. Today, in addition to being professor at NTNU, Ursula Gibson simultaneously holds adjunct professorships at the KTH Royal Institute of Technology and at Dartmouth College.

Talk abstract: Status and Potential of Semiconductor-core fibers

Glass fibers with crystalline semiconductor cores have potential for optoelectronic device fabrication from solar cells to optical detectors. They are also being investigated for all-optical signal processing and as photonic relays for on-chip and data center data transfer. This talk will review some of the optical and electronic properties observed to date, as well as the materials processing techniques possible in this geometry that promise to make these materials of even greater interest going forward. Recent results suggest the potential use of these materials for making in-fiber long wavelength lasers, and even the possibility of using them for fabrication of alloys with novel magnetic properties.

Kurt Wüthrich

Thursday 16:30

Kurt Wühtrich is a Professor of Biophysics at ETH Zürich, as well as Cecil H and Ida M. Green Professor of structural biology at the Scripps Research Institute in La Jolla, California. He received the Nobel Prize in Chemistry in 2002 for his developments in nuclear magnetic resonance techniques.

Wüthrich studied natural sciences at the University of Bern from 1957 to 1962. He thereafter wrote his doctoral thesis about the catalytic activity of copper compounds in autoxidation reactions. This work was done at the University of Bern under supervision of Silvio Fallab. Since then, he has been working at UC Berkley and Bell Laboratories, and has been a visiting professor at the University of Edinburgh, the Chinese University of Hong Kong, as well as Yonsei University. Now he is heading laboratories at the ETH Zürich, at the Scripps Research Institute and at the iHuman Institute of ShanghaiTech University. He currently focuses on determining the structural composition of biological macromolecules, especially G protein-coupled receptors. These structures can be examined using nuclear magnetic resonance methods developed by Wüthrich himself. Based on this work, Wühtrich was awarded the Nobel Price in chemistry in 2002 "for his development of nuclear magnetic resonance spectroscopy for determining the three-dimensional structure of biological macromolecules in solution".

Talk abstract: NMR and MRI in 2018 – Fruits from Two Centuries of Basic Research

NMR (nuclear magnetic resonance) presents a nice illustration of the important role of fundamental research for improved quality of human life. At the outset of today's lecture, we will consider what is expected today from applications of the NMR principle in medical diagnosis and in biological and biomedical research. Then the roots in basic research will be explored which enabled these present-day applications. It all started in the 19th century and for his work in the 1890s, Pieter Zeeman shared the 1902 Physics Nobel Prize with Hendrik Antoon Lorentz "in recognition of the extraordinary service they rendered by their researches into the influence of magnetism upon radiation phenomena". In 1952, Felix Bloch and Edward Purcell were awarded the Nobel Prize in Physics for the description of the NMR experiment, which detects transitions between the "Zeeman levels" of isotopes with non-zero nuclear spin quantum number. After two decades of NMR applications for fundamental studies in physics and as an analytical tool in chemistry, the early 1970s saw novel concepts and advances in instrumentation and computation, which laid the foundations for magnetic resonance imaging (MRI), which is today a key technique in medical diagnosis (2003 Nobel Prize in Physiology or Medicine to Paul Lauterbur and Peter Mansfield) and for the use of NMR spectroscopy in structural chemistry and biology (Nobel Prizes in Chemistry to Richard R. Ernst 1991 and KW 2002). Fundamental understanding of these advances was greatly helped by Albert Einstein's 1905 treatise of the Brownian motion described by the English botanist Robert Brown in 1827, which leads to a deeper understanding of NMR with solutions, including body fluids.

Sofie Snipstad

Friday 11:30

Sofie Snipstad is one of NTNU's own post-docs at the department of Physics.

Her research revolves around improving cancer treatment, and builds upon her PhD work. By taking advantage of medicine encapsulated into nanoparticles combined with the employment of ultrasound, cancerous cells are targeted more precisely. If successful, it may allow for safer and cheaper cancer treatment.

Talk abstract: Nanomedicine and ultrasound for treatment of cancer and brain disease

Chemotherapy is limited by inadequate delivery to the tumor and severe side-effects due to accumulation in healthy tissues. Encapsulation of drugs in nanoparticles can enable a more targeted delivery, improved efficacy and reduced toxicity. However, delivery of nanoparticles is often insufficient due to various biological barriers in the tumor. Drug delivery to the brain is also severely restricted due to the blood-brain barrier, limiting treatment of a range of brain diseases. Ultrasound in combination with microbubbles has emerged as a promising method to enhance delivery of nanomedicines. The biomechanical effects from the oscillating microbubbles enhance permeability of the vascular wall and improve extravasation and distribution of the nanoparticles in the tumor, resulting in enhanced therapeutic efficacy. We investigated two novel microbubble-platforms; a multifunctional drug delivery system consisting of microbubbles stabilized by nanoparticles, and another highly interesting system based on clusters of microbubbles and microdroplets which phase shift and turn into large microbubbles that temporarily block the capillaries. We demonstrated increased uptake and distribution of nanomedicines in tumors in mice, leading to increased survival. The same technique can also be used to open the blood-brain barrier in a non-invasive, localized and reversible manner, and we have shown that the two microbubble-platforms can also be used to deliver drugs to the brain. We are now investigating the underlying mechanisms, which will enable us to further optimize the treatment, and to move ultrasound-mediated delivery of drugs closer to clinical practice.

Evening activities

Every evening of the conference we invite all of our delegates to participate in a social activity, that will display Trondheim's history and culture, and bring our delegates closer together.

Tuesday 18:00 - Dinner at Lian
The first evening of INASCON 2018 will be offering participants the possibility of a trip on the historic old tramline from 1933. It will start in Trondheim city centre and end near to the classic Lian Restaurant, where we will be having dinner. The tramline has been in use since the early 20th century and continues to this day to connect downtown Trondheim with the nearby woodlands recreation area around "Lianvannet" lake, through a scenic path up a hillside west of the city.

Wednesday 19:30 - Concert in Nidarosdomen
On this evening we will visit the Nidaros Cathedral where we will experience an organ concert played on one of Norway's most beautiful instruments. The building of this cathedral was started in year 1070 and assumed completed around year 1300. It's the oldest cathedral in Norway, and the northernmost in the world.

Doors open at 19:15 and we will walk together from the university Campus around 18:45.

Wednesday 20:00 - Quiz in Kieglekroa
After a long and busy day we would like to invite all participants to come with us to Kieglekroa, a bar in the center of Trondheim, not far from Nidarosdomen. There will be a quiz! Note that this is of course completely optional, and that it is very understandable if one wish to go home to relax after a busy and eventful day.

Thursday 19:00 - Banquet at Samfundet (Student Society)
The last night of the conference, there will be a Banquet with great food and entertainment. It will take place at Samfundet, just a 2 minute walk down from campus Gløshaugen at NTNU. The house was finished in 1929, after two years of construction, and has since been the main gathering place for all students in the city. It is owned by the more than 13 000 members of the Student Society. The building has been rehabilitated several times, keeping it relevant and exciting.

We are all very excited to show you this great, red round house and all that is has to offer!

Workshops

Wednesday 11:15 - Workshop with Diatoma
Diatoma will host this interesting workshop, titled: Pitching crash course: Explaining your research to grandma.

Friday 9:00 - Workshop with Mats Broden and Shaun Braastad
Mats Broden and Shaun Braastad are hosting a workshop on how nanotechnology can be used in business and industry to solve the technological issues of tomorrow. This event will give the participants an opportunity to think for themselves, and brainstorm on how nanotechnology can be used in the future.
Mats Broden is co-founder and CEO of Embedded Nano. He is working on finding new ways to commercialize nanoetechnology, and making the industry and business world more aware of what issues can be solved using nanotechnology.
Shaun Braastad is Special Advisor at NTNU Accel - NTNUs very own business incubator. He has more than ten years experience in technology entrepreneurship.
Additionally, a representative from the International Iberian Nanotechnology Laboratory will be there.

Various activities

Poster sessions
PhD candidates will present their research posters on Thursday at 13.45 in a session where everyone is welcome to check out in which direction nanotechnological research is headed. The best posters will be awarded at Friday.

Panel discussion
On Wednesday we will host a panel discussion how nanotechnology could impact production, storage and consumption of energy in the future. The participants will be: Fride Vullum-Bruer, expert on batteries and Associate Professor at Department of Materials Science and Engineering NTNU; Ingrid Snustad, lead researcher at SINTEF Energy Research, a part of one of Europe's largest independent research organizations, and PhD candidate working on nanostructured materials for carbon capture; and Jianying He, Professor at Department of Structural Engineering NTNU, and expert on oil extraction.

Company presentations
Throughout the conference, interesting companies will promote themselves on stands, and we encourage participants to check out what they have to say. Additionally, some companies will have presentations.

Lunch, snacks and refreshments
Everyday at 12:15 (13:00 on Tuesday) we will serve lunch in Hangaren, a cafeteria located at campus. Here you will be given a baguette of choice and a selection of re-freshing beverages. During the breaks, we will provide snacks, fruits, coffee and tea.

Presentations abstracts

Ce,Y-modified double-layered hydroxides as catalysts for dry methane reforming: The effect of yttrium promotion

Katarzyna Świrk[1,2], Monika Motak[2], Maria Elena Gálvez[1], Teresa Grzybek[2], Magnus Rønning[3], Patrick Da Costa[1]

[1] Sorbonne Université, CNRS, Institut Jean Le Rond d'Alembert, F-78210 Saint Cyr l'Ecole, France
[2] AGH University of Science and Technology, Faculty of Energy and Fuels, 30-059 Cracow, Poland
[3] Norwegian University of Science and Technology, Department of Chemical Engineering, N-7491 Trondheim, Norway

Double-layered hydroxides (DLHs) have a variety of potential applications including catalysis, due to their proper basicity and the possibility of ion-exchange of di- and tri-valent cations. The modification of such materials with Ni may result in homogenous distribution of the metal, the latter playing the role of active site in the methane reforming processes. However, the disadvantage of Ni-containing DLHs as catalysts for dry methane reforming (DRM, $CH_4 + CO_2 = 2H_2 + 2CO$) is their unstable catalytic behavior due to carbon deposition. [1,2] Promotion with cerium (Ce) has been reported as promising for Ni-based double-layered hydroxides. [2,3] As described by several authors, the cerium modification contributes to the increased catalytic stability in DRM, due to higher oxygen capacity. [2,3] Also, Y-doped ceria supports revealed improved catalytic performance, which was assigned to better interactions of metal–support and generation of oxygen vacancies.[4]

In this study, nickel double-layered hydroxides were modified with Ce (3 wt.%) and Y (0.2, 0.4, or 0.6. wt.%) and tested in DRM. All promoted catalysts were characterized by XRF, N_2 sorption, XRD, H_2-TPR, CO_2-TPD, HRTEM and TGA/DSC-MS in order to determine the physicochemical properties. The dry impregnation with yttrium resulted in (i) an increase of specific surface area, (ii) a decrease in reducibility of the nickel, (ii) smaller Ni° crystallite size, and (iv) a deposition of ceria on the surface of the catalyst. The dry methane reforming tests were carried out in a fixed-bed quartz reactor at atmospheric pressure from 600 to 850°C, under following conditions: flow 100 ml/min, $CH_4/CO_2/Ar=1/1/8$ and a GHSV=20,000h^{-1}. A lower carbon formation for Ymodified samples was observed.

Acknowledgements

K. Świrk acknowledges the French Embassy and InnoEnergy PhD School for financial support. The KinCat Catalysis Group at NTNU is gratefully acknowledged for the possibility to conduct this research by K. Świrk. T. Grzybek and M. Motak thank AGH grant 11.11.210.373.

References:
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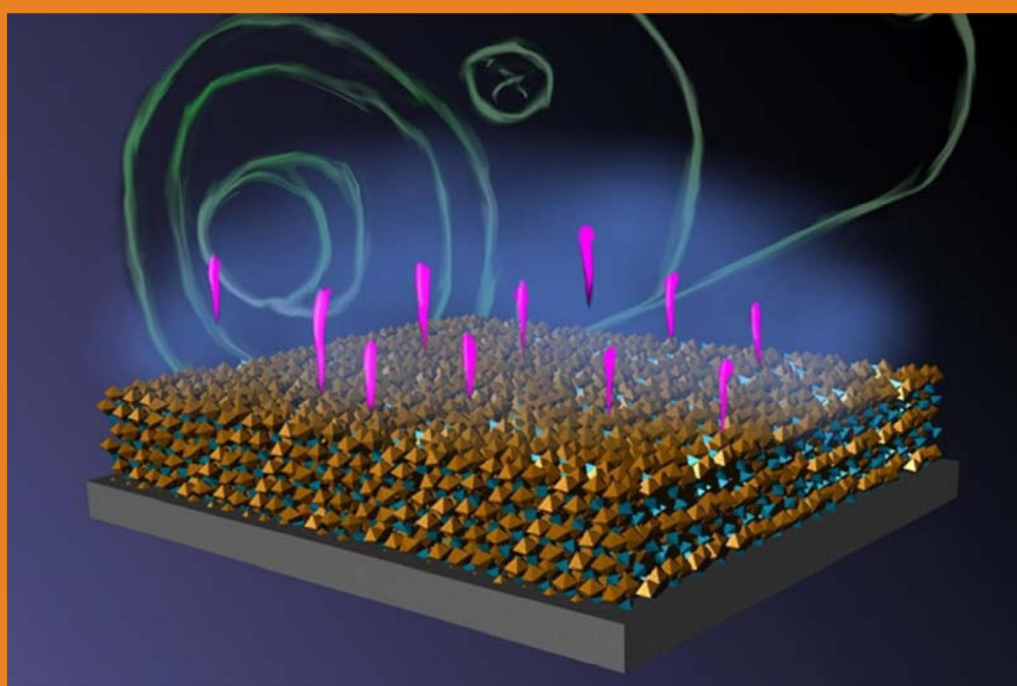
[3] C.E. Daza, S. Moreno, R. Molina, Co-precipitated Ni-Mg-Al catalysts containing Ce for CO2 reforming of methane, Int. J. Hydrogen Energy. 36 (2011) 3886–3894. doi:10.1016/j.ijhydene.2010.12.082.
[4] J.B. Wang, Y.S. Wu, T.J. Huang, Effects of carbon deposition and de-coking treatments on the activation of CH4 and CO2 in CO2 reforming of CH4 over Ni/yttria-doped ceria catalysts, Appl. Catal. A Gen. 272 (2004) 289–298. doi:10.1016/j.apcata.2004.05.053.

Thin film electrolytes at UiO

Kristian B. Kvamme

Batteries are fast becoming the go-to energy storage solution of our future, even for highly demanding applications such as aviation. The growing expectations and demands for our future batteries require radical improvements in both design and construction. Several approaches are being pursued throughout the research community. At UiO, we are exploring solid-state electrolytes to fulfil these demands. Changing from a liquid to a solid electrolyte is a drastic change in battery design, and solid electrolytes will significantly improve the properties of batteries. This will in turn enable new applications and further decouple our civilization from fossil fuels. Most solid materials have low ionic conductivity, but not all. We are exploring solid materials with high ionic conductivity, including combinations of organic and inorganic structures forming a class of hybrid materials. This work is based on our previous, successful work on high-performance $FePO_4$ cathode materials that show quasicapacitive behaviour.



Phase transition enable durable icephobic surfaces and its DIY design

Feng Wang

NTNU Nanomechanical Lab, Department of Structural Engineering, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway.

Generally, it is a great challenge to improve the longevity and durability of slippery liquid infused porous surfaces (SLIPS) when they are applied in icephobic field. Phase transformable slippery liquid infused porous surfaces (PTSLIPS) are fabricated in this work to overcome these tough barriers. The mechanism bases on the physical property of lubricant that convert into solid state before water freezing. Peanut oil infused porous PDMS substrates show low ice adhesion strength (4.45 ~ 22.43kPa) as well as excellent durability. For selected samples, low ice adhesion strength around ~ 16kPa maintains after 30 icing/de-icing cycles due to enhanced stability of lubricant originates from phase transition. In addition to promising ice adhesion strength and durability, PTSLIPS also suit to various substrates with numerous chemical compositions (both hydrophobic and hydrophilic materials), wide pore size distributions and diverse pores morphologies. PTSLIPS with reasonable ice adhesion strengths (14.13 ~ 280.33kPa) are fabricated with substrates (wipers, foams and paper) that can be found easily from household garbage and lab supplies. We demonstrate the possibility of icephobic surfaces to DIY by people at home with porous materials in hand. The PTSLIPS also possess self-healing property that enables PTSLIPS with excellent physical damage resistance. Scratches on PTSLIPS have small effects on the ice adhesion strength of samples. Therefore, PTSLIPS are potential to have large scopes of applications.

Hybrid mesoporous non-silica catalyst supports by non-hydrolytic sol-gel methods

Petr Machac[1], Ales Styskalik[1,2], Johan Alauzun[3], Hubert Mutin[3], Jiri Pinkas[1,2]

[1]Department of Chemistry, Masaryk University, Kotlarska 2, CZ-61137 Brno, Czech Republic
[2]CEITEC MU, Masaryk University, Kamenice 5, CZ-62500 Brno, Czech Republic
[3]Institut Charles Gerhardt Montpellier, UMR 5253, CNRS-UM-ENSCM, Université de Montpellier, Place Eugène Bataillon, CC1701, F-34095 Montpellier Cedex 5, France

A lot of reactions in chemical industry require presence of catalysts. That makes development of novel and efficient catalysts relevant. It is generally known that reaction rate strongly depends not on bulk catalyst concentration but on concentration of accessible catalytic sites given mainly by catalyst surface area (SA). Since it is not an easy task to introduce high SA directly into catalytic active metals, catalyst supports are widely used. Efficient supports feature high SA and pores of uniform size, which are easily accessible for reactants. Inner walls of pores can either carry the active metal or be active on their own. These properties allow reaching high efficiencies even with low loadings of transition metals due to enhanced accessibility of catalytic sites.

Attractive supports are organic-inorganic hybrid materials as they combine inorganic network rigidness with properties brought by the organic building blocks, controlled hydrophobicity and improved hydrothermal stability. Organosilicas are suitable supports, but their applications are limited by decomposition at high pH.1

Herein we present an unconventional synthetic route to mesoporous aluminum phosphates and phosphonates. The xerogels were prepared by non-hydrolytic sol-gel methods using silylamine elimination.2 Synthetic procedure was optimized in order to prepare amorphous and mesoporous materials based on networks of Al–O–P bonds with SA higher than 1 000 m2g−1. Products were characterized by various techniques including MAS NMR, TEM, BET, etc.

Acknowledgements

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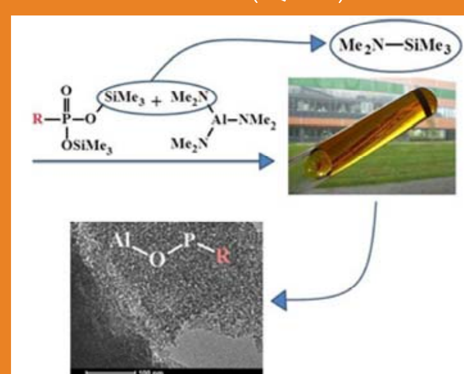

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Porous structure controlled adhesion failure for icephobicity

Tong Li, Jianying He and Zhiliang Zhang

NTNU Nanomechanical Lab, Department of Structural Engineering, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway

Ice accretion has caused severe problems for infrastructures and transportations, such as collapse of grid infrastructures, failure of turbine blades and traffic accidents. The active approach has been generally used for tackling these problems, such as heating, chemical and mechanically removing ice, which is energy consumption and/or environmental pollution. Hence, some passive icephobic materials are developed, including superhydrophobic surface, slippery surfaces, and slippage-induced icephobic surfaces. However, these methods are not either durably icephobic, chemically stable or mechanically robust, as removable lubricants are used.

Herein, based on the adhesion failure mechanism, we tackle ice accretion by designing structured elastomeric coatings with super low adhesion to ice. Elastomers with varied pores were investigated for icephobic surfaces. The corresponding mechanisms were revealed as the crack mechanism and the elastic modulus reduction mechanism. Furthermore, an overview of the advantages and disadvantages were revealed for these different icephobicity mechanisms. In contrast to other mechanisms, the structure-induced icephobicity provide a facile and novel strategy to get mechanically and chemically stable and durable icephobic materials. Our structure-induced adhesion failure for ice shed light on an effective approach to tackle the ice accretion problem.

Design of carbon/metal oxide hybrids for electrochemical energy storage

Simon Fleischmann[1,2], Volker Presser[1,2]

[1] INM - Leibniz Institute for New Materials, 66123 Saarbrücken, Germany
[2] Department of Materials Science and Engineering, Saarland University, 66123 Saarbrücken, Germany

The transition from fossil to renewable energy sources for power generation and the electrification of the mobility sector are highly dependent on the availability of fast and efficient electrochemical energy storage devices (EES). Two general groups of EES can be identified according to their charge storage mechanism: (1) Batteries employing faradaic reactions between the ions of the electrolyte with the *bulk volume* of the electrodes, and (2) supercapacitors using the formation of the electrical double-layer at the *electrode/electrolyte interface*.[1] While faradaic reactions yield high a high energy storage capacity for batteries, their power is kinetically limited by solid state diffusion, leading to long charging times. In contrast, the surface process of supercapacitors enables very high power, but the absence of chemical reactions results in relatively low energy. A synergistic combination of these technologies on both a materials level and a device level can be achieved by a hybridization approach, resulting in an improved electrochemical performance (Fig. 1).[2]

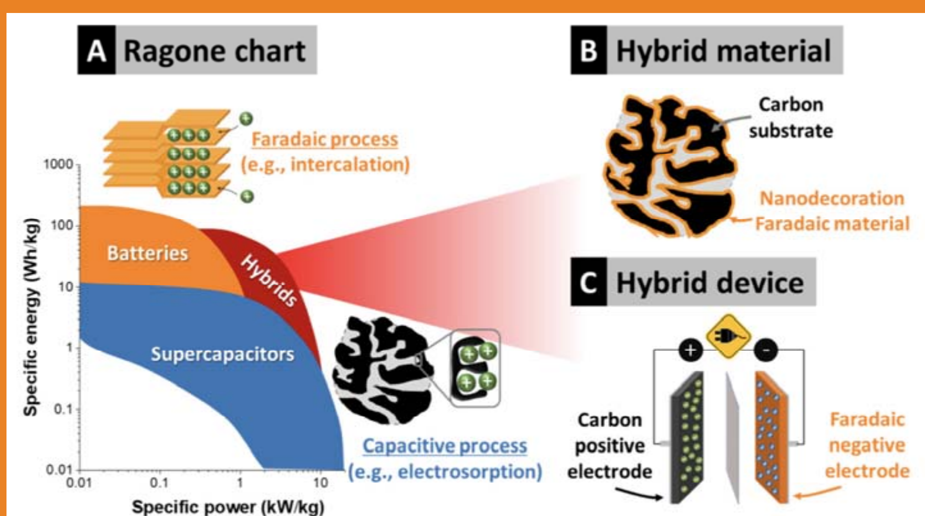

Figure 1: Comparison of supercapacitors, batteries, and hybrids thereof.[2]

This talk will outline design strategies for hybrid materials containing high surface area carbons and metal oxide thin film phases that are linked on a nanoscopic level. The advantages and disadvantages of all approaches are highlighted and strategies to overcome the latter will be proposed.

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Cation disordering in tetragonal tungsten bronzes

S. S. Aamlid[1],* S. M. Selbach[1], and T. Grande[1]

[1]Department of Materials Science and Engineering, NTNU Norwegian University of Science and Technology, NO-7491 Trondheim, Norway

*Corresponding Author: solveig.s.aamlid@ntnu.no

The search for lead-free piezoelectrics that can replace our currently best-performing albeit lead-containing piezoelectric PZT is an ongoing worldwide effort [1]. In this work, cation order is proposed as a processing parameter to tailor the ferroelectric properties in tetragonal tungsten bronze (TTB) materials, which are the second most important class of piezoelectrics. The general TTB formula is $A2_4A1_2C_4B_{10}O_{30}$. The A1 and A2 cation sites are of similar size, as shown in Figure 1, and may accommodate similar types of cations such as alkali, alkaline earth, and lanthanoid elements. In this work, we explore the effect of cation disordering in the solid solution $Sr_{5x}Ba_{5-x}Nb_{10}O_{30}$ (SBN, 0.25<x<0.75). SBN is an unfilled tungsten bronze, meaning that one of the A sites are vacant and the remaining five are occupied by a mixture of Ba and Sr. Ba prefers the A2 site while Sr weakly prefers the A1 site. The effect of cation disordering on the critical temperature has been investigated in SBN before, but not well explained [2]. First principles DFT simulations of the end members in SBN have demonstrated that several cation configurations are similar in energy, and that the degree of disorder with thermal history depends on the Sr/Ba ratio [3]. The effect of cation disordering is observed at the macroscopic scale, while the phenomena occur at the atomic scale.

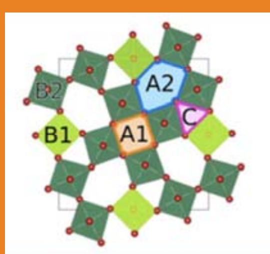

Figure 1. The tetragonal tungsten bronze structure, showing the large pentagonal A2 sites and the smaller square A1 sites.

Dense pellets of SBN in four compositions were prepared by solid state synthesis and samples were quenched from high temperatures to freeze in various degrees of cation disorder. The effect of the thermal history was characterized experimentally by dielectric spectroscopy, ferroelectric hysteresis measurements, and X-ray diffraction. Quenching from a higher temperature resulted in higher critical temperature, ferroelectric hardening, increased tetragonality of the unit cell, and the movement of vacancies from the A2 to A1 position [4]

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Nanoparticle synthesis of Bi, Ni, Sn and their alloys potentially applicable as lead-free nanosolders

Tomas Boruvka[1], Vit Vykoukal[1,2], Frantisek Zelenka[1], Jiri Pinkas[1,2*]

[1]Faculty of Science, Masaryk University, Department of Chemistry, Kotlářská 2, 611 37 Brno, Czech Republic
[2]CEITEC MU, Masaryk University, Kamenice 5, 625 00 Brno, Czech Republic

Metal nanoparticles and their alloys are promising materials which can be possibly applicable as lead-free solders.1 Some materials are barely applicable due to their high melting points despite their good mechanical properties. Particles with diameters under 100 nm can display a melting point depression which is caused by surface energy contribution as it is explained in the Gibbs-Thomson equation2 (1). This phenomenon is possibly a solution for practical use of solders with high melting points in bulk scale.

$$\Delta Tm = Tm - Tm(d) = 4\sigma sl Tm d \Delta H f \rho s \quad (1)$$

Tm is melting point, σsl is surface energy of solid-liquid interface, d is diameter of particle, Hf is bulk enthalpy of fusion and ρs is density of solid.

In our research a synthetic process is optimized to be useful for all the above mentioned metals and alloys with satisfactory results to prepare nanoparticles with diameters below 100 nm featuring melting point depression. Obtained nanoparticles and nanoalloys are characterized by an array of techniques with focusing on describing size distribution and phase transformations. Their phase transformations and thermal behavior are compared with theoretical phase diagrams of bulk and nanomaterials. In cases where nanoparticles display large melting point depression, the materials are considered for possible application as solders.

In this work we specifically targeted Bi, Ni and Sn nanoparticles and their binary nanoalloys prepared by reduction synthesis at laboratory temperature. The size distribution of studied nanoparticles and nanoalloys depends on used system and influences the value of melting point depressions. However, for all of mentioned systems, nanoparticles with diameters under 50 nm were obtained. Synthesized nanoparticles were characterized by electron microscopy, powder x-ray diffraction and differential scanning calorimetry.

Keywords: Nanoparticles, Tin, Melting point depression, reduction synthesis, DSC, TEM, SEM, PXRD

Aknowledgements:
This research has been financially supported by the Czech Science Foundation (GA 17-15405S) and the Ministry of Education, Youth and Sports of the Czech Republic under the project CEITEC 2020 (LQ1601). TEM and SEM analyses were carried out under the CIISB research infrastructure project LM2015043 financed by MEYS CR.

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Surfactant modified cellulose nanofibrils for enhanced oil recovery

Trygve Jakobsen[a], Ellinor Bævre Heggset[b], Sébastien Simon[a], Kristin Syverud[b], Kristofer Paso[a].

[a]Norwegian University of Science and Technology, N-7491, Trondheim, Norway;
[b]RISE PFI, Høgskoleringen 6B, N-7491, Trondheim, Norway;

Nanocelluloses have shown promising results as rheology modifiers in water dispersions and as emulsion stabilizers. As non-toxic biomaterials, they show good potential as additives in enhanced oil recovery. This biodegradable class of materials could potentially replace nondegradable synthetic polymers used in oil production and prevent their release into the ocean. As an initial study, commercially available model surfactants has been combined with cellulose nanofibrils, and an investigation has been conducted on the nature of surfactant adsorption onto fibrils, change in rheological behavior and surface tension. EOR systems are subject to harsh and variable conditions, including high salt concentrations, temperatures and shear forces, acidic environment, microbial activity and extreme pressures. The effect of these parameters has been taken into account during investigation.

Electrochromic WO_3 Thin Films Prepared by Sputtering Technology

Yingpeng Zhen[1*], Tao Gao[1], and Bjørn Petter Jelle[1,2]

[1]Department of Civil and Environmental Engineering, Norwegian University of Science and Technology (NTNU), NO-7491 Trondheim, Norway.

[2]Department of Materials and Structures, SINTEF Building and Infrastructure, NO-7465 Trondheim, Norway.

*Corresponding author: email: yingpeng.zhen@ntnu.no

Electrochromic (EC) materials are able to change their optical properties by applying an external voltage, e.g., changing from a dark colored state to a transparent state with no color tints. EC materials can be used to assemble smart windows for the utilization in energy-efficient buildings. Using EC smart windows, the amount of solar radiation transmitted through windows can be controlled, thereby decreasing the energy consumption of buildings by reducing a certain amount of heating, cooling, and lighting loads.

WO_3 is probably the most studied EC material for smart window applications. There are many different methods being utilized for WO_3 film preparation, which among others include physical/chemical vapor deposition, sputtering, electrodeposition, sol-gel deposition, etc.

In this work, WO_3 thin films with a thickness of about 36 nm were prepared by using a radio frequency (RF) sputtering method.

The morphology and microstructures of the asprepared WO_3 thin films were characterized by means of X-ray diffraction, scanning electron microscopy (SEM), and Fourier transform infrared (FTIR) spectroscopy. The transmittance of the samples was measured with a UV-VIS-NIR spectrophotometer.

WO_3 films changed color from colorless to blue during electrochemical cycles, thus demonstrating a potential for assembling EC smart windows to modulate the transmitted solar radiation.

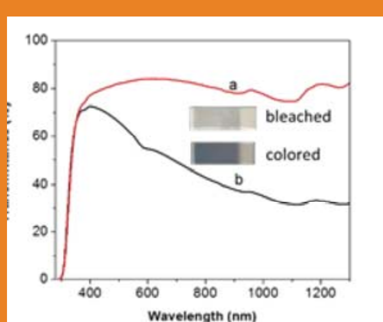

Fig 1. Transmittance spectra of a 36 nm WO_3 thin film electrode at (a) bleached and (b) colored state. Coloration and bleaching of the WO_3 thin film electrode (deposited on ITO glass) are performed with a 3-electrode electrochemical cell with WO_3 thin film, Pt wire, and Ag/AgCl (3 M KCl) being the working electrode, counter electrode, and reference electrode, respectively. The electrolyte is 0.5 M H_2SO_4 aqueous solution. Colored and bleached states are obtained by maintaining a constant potential at -0.5 and 0.5 V (vs. Ag/AgCl), respectively, for 3000 s.

Pulsed laser deposition of ferroelectric oxides on silicon for neuromorphic applications

Yorick Birkhölzer, Ufuk Halisdemir, Gertjan Koster, Guus Rijnders

Department of Inorganic Materials Science, MESA + Institute for Nanotechnology
University of Twente, PO Box 217, Enschede, The Netherlands

y.a.birkholzer@utwente.nl

Inspired by the biological architecture of the brain and with the goal to mimic the processes underlying learning and memorization, we are developing memristive ferroelectric tunnel junctions (FTJs) for applications in neuromorphic computing, which allows for highly energy efficient and massively parallel data processing and storage.

FTJs are non-volatile memory devices with non-destructive readout whose resistance can be tuned by polarization reversal of a nanometer-thick ferroelectric layer sandwiched by two dissimilar metallic electrodes. Recently, several groups demonstrated the possibility to continuously tune the resistance of FTJs between the ON and OFF state [1,2]. Such memristive behavior is the key to mimic synaptic behavior in artificial neural networks and is realized through partial polarization switching of nanodomains within a single FTJ device [3].

For actual applications of complex oxides and industrial feasibility it is important to upscale sample fabrication processes from the millimeter to the wafer scale and replace the special, small, single-crystalline oxide substrates, which were used for epitaxial thin film growth in previous work, by buffered silicon wafers. Pulsed laser deposition (PLD) system is used to grow layers with atomically well-defined, sharp interfaces, which are a prerequisite for FTJs.

In this talk, I would like to show how we optimized the PLD parameters to grow ultrathin lead-free ferroelectric oxides, $BiFeO_3$ and $BaTiO_3$, and conducting $LaNiO_3$ and $SrRuO_3$ bottom electrode layers on $SrTiO_3$ buffered Si wafers [4]. Atomic force microscopy (AFM), X-ray Reflectivity (XRR) and Diffraction (XRD) are used to confirm the required flatness of less than 1 nm peak-to-peak roughness and epitaxy, respectively. Piezoresponce force microscopy (PFM) is used to investigate the ferroelectric properties in the ultrathin limit.

Future work includes the fabrication of crossbar arrays and their integration with CMOS, eventually demonstrating machine learning capabilities such as pattern recognition in hardware.

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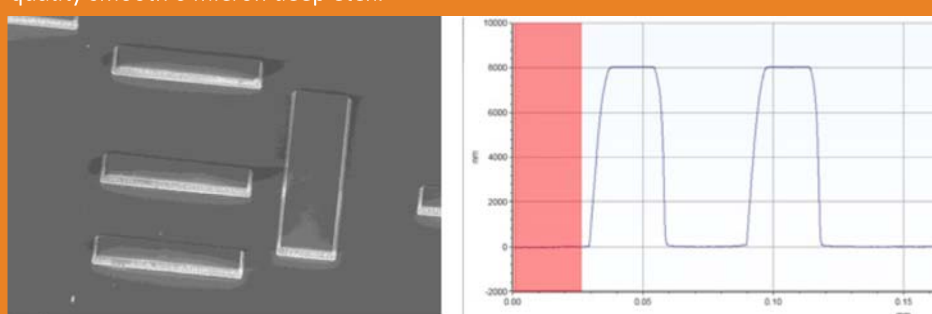
High Quality Deep Etching of Diamond: Process Optimisation of an Iterative Ar/O2 and Ar/Cl2 ICP Reactive Ion Etch for Power Device Fabrication

M-L. Hicks, A. C. Pakpour Tabrizi, R. B. Jackman

Diamond is the ultimate semiconductor for power electronics due to its exceptional electrical and thermal properties. Its high dielectric breakdown strength, carrier mobility and thermal conductivity have the potential to offer a step change improvement in efficiency and reliability, compared to existing silicon-based devices. In 2014, 8.3% global electrical power was lost in transmission and distribution in the electric grid. Recent progress in high quality synthetic diamond growth has opened the door for the fabrication of diamond power electronic devices making full use of its exceptional properties and potential for improving the electric grid for our future low-carbon society.

Reactive Ion Etching (RIE) has emerged as a preferred method for diamond substrate surface treatment and device patterning. This process is crucial to achieve the fabrication of high power devices fully exploiting the exceptional properties of diamond. The material properties of diamond however pose challenges to achieving smooth etched surfaces, especially for etch depths beyond 2 microns. Following work optimising Inductive Coupled Plasma RIE etching for surface smoothing and removal of sub-surface damage, an investigation into the effects of etch process parameters on diamond patterning is pursued. The aim is the achievement of deep etching with controlled wall angle, minimized micromasking and etched surface damage. More specifically, the impact of gas ratio and ICP power settings on the physical and chemical properties of the etch is studied with relation to mesa quality. Results high-light the importance of platen power, increased O2/Ar gas ratio and intermittent Ar/Cl2 plasma to reduce damage and micromasking on the etched surface, producing a high quality smooth 8 micron deep etch.



(a) Patterned (100) diamond surface with 8 um (b) Etched feature height, Dektak profilometer features

(sidewalls appear bright), tilted SEM scan. image (30˚, 10 keV).

Figure 1: 8 micron deep features produced on (100) single crystal diamond surface using the optimized iterative ICP reactive ion etch with Ar/O2 and Ar/Cl2. (a) Tilted SEM image of the etched surface and mesas, with no micromasking (uniform etched surface with near to no protrusions from micromasking). (b) Profilometer scan illustrating the height of the etched features and smoothness of the etched surface.

Filming sub-ns magnetization dynamics in a spintronic device

Einar Digernes[1], Jonathan Leliaert[2], Per Erik Vullum[3,4], Bartel Van Waeyenberge[2], Erik Folven[1]

[1] Department of Electronic Systems, NTNU – Norwegian University of Science and Technology, Trondheim, Norway
[2]Department of Solid State Sciences, Ghent University, Gent, Belgium
[3]Materials and Chemistry, SINTEF, Trondheim, Norway
[4]Department of Physics, NTNU – Norwegian University of Science and Technology, Trondheim, Norway

The use of electron spin as an information carrier is the basis for spintronics, and is used in applications such as non-volatile memory and in the read heads of magnetic hard drives. Spintronics is expected to play a critical role in future information processing technologies, where promising aspects such as low power consumption, radiation resistance and new computer architecture are envisioned.

Hand in hand with the development of new spintronic devices is the need for more powerful characterization tools. Recent development in synchrotron based x-ray transmission techniques makes it possible to assess magnetic structures with nanometer spatial resolution and sub-nanosecond temporal resolution (fig. 1). However, this technique requires samples not thicker than about 500 nm in order to allow for transmission of soft x-rays, hence leaving out many systems. We have established the methodology to selectively cut out a spintronic device from its substrate and place it on top a 150 nm thick Cu strip line defined on a soft x-ray transparent membrane (fig. 2). The model system is a micromagnet defined in ferromagnetic La0.7Sr0.3MnO3 grown on SrTiO3.

Preliminary data revealing magnetization dynamics in the micromagnet cutout upon field excitation will be presented. The method is general and enables probing the magnetization dynamics in a wide range of materials systems.

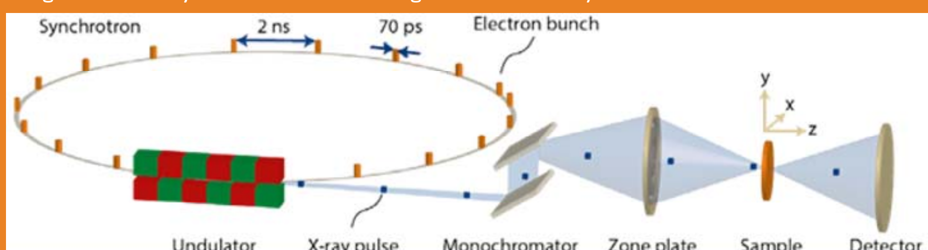


Figure 1 Schematic layout of synchrotron based scanning transmission x-ray microscopy

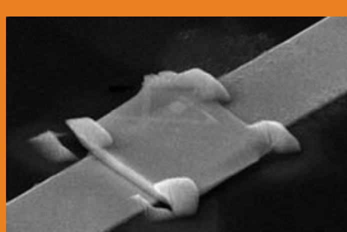


Figure 2 Lamella with embedded micromagnet on top of Cu strip line

Towards the development of novel carbon based materials for on-chip supercapacitor and Support your education and research by EU funds

Chengjun Yu[1], Sen Mei[2], Xuyuan Chen[1*]

[1]Department of Microsystems, University College of Southeast Norway, Borre, Norway
[2]Department of Materials and Nanotechnology, SINTEF Materials and Chemistry, Oslo, Norway
cy@usn.no

With the rapid development of the global economy, the depletion of fossil fuels, and increasing environmental pollution, there is an urgent need for efficient, clean and sustainable sources of energy, as well as new technologies associated with energy conversion and storage. Supercapacitors or electrochemical supercapacitor can bridge functions for the power/energy gap between traditional dielectric capacitors (high power output) and batteries/fuel cells (high energy storage), which make supercapacitors can be used in a variety of emerging energy applications. In addition, the supercapacitors can provide fast charge/discharge rates, and long cycle lifetimes. Therefor, more and more researchers pay attention to the theoretical and practical and development of supercapacitors and a large number of research articles and technical reports have been published.

In this project, the key challenges by self-assembling carbon nanotube (CNT), graphene and other carbon materials with engineered nanoarchitectures are addressed. The innovative materials approach is the use of silicon nano-taper array decorated with nano particles (NPs) for catalytic growth to construct functional 3D templates, and of low dimension carbons in the form of CNT or graphene to construct 3D nano-architectures. Our hypothesis is that silicon nano-taper array with engineered density and shape will prove to be the most effective functional structure for template-assisted self-assembling the electrodes of supercapacitors. The resulting electrodes exhibit optimized configuration of pores, quantitative electrochemical accessibility, and the use of maximized active material sustaining fast charging rates.

As a previous Erasmus+ and Marie Curie Fellowship holder, I'll also talk on how to support your education and research by EU funds, which could be very attractive to young students and researchers.

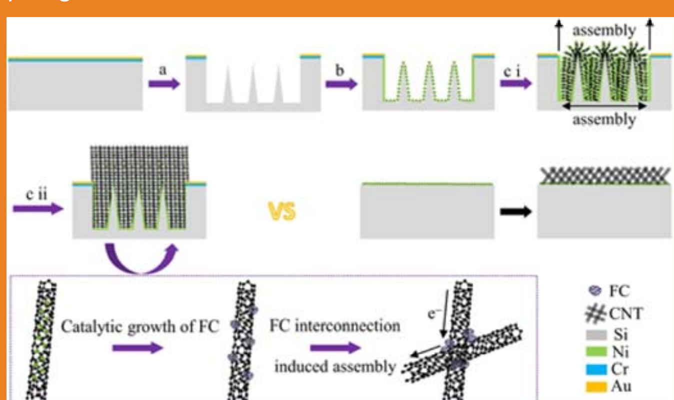


Figure 1. The process of producing CNT on-chip supercapacitor electrode

Modified boron doped diamond electrodes for the trace detection of mercury

Maeve McLaughlin, Richard B. Jackman

London Centre for Nanotechnology and Department of Electronic and Electrical Engineering, University College London, 17-19 Gordon Street, London, WC1H 0AH, UK

maeve.mclaughlin.16@ucl.ac.uk

Mercury is a highly toxic heavy metal that even in trace concentrations poses a severe threat to both human health and the environment because it tends to form complexes with biological matter, leading to an accumulation in the food chain [1]. Mercury can be released into potable water sources through contamination from crude oil processing wastewater streams. The World Health Organisation guideline for the maximum safe quantity of mercury in drinking water is 6 µgl-1 ca. 30 nM [2]. It is imperative that trace contamination of potable water is identified in situ. This can be achieved through electrochemical techniques, which also have the advantage of relative low cost and simplicity compared to optical methods.

In this work square wave anodic stripping voltammetry (SWASV) was used with a boron doped diamond (BDD) working electrode in a nitric acid electrolyte (0.1 M). This system is considered to be one of the most sensitive electro-analytical techniques for trace analysis, with detection of mercury recorded here in the pico-molar range. BDD electrodes are particularly well suited for the trace detection of mercury due to the wide electrochemical window, low background currents, resistance to fouling and stability at extreme temperature, pressure and pH associated with the material [3]. A comparison study was made to determine how the deposition of varying sizes of gold nanoparticles on the BDD surface influences the sensitivity of the electrode. The gold nanoparticles act catalytically during the initial step of SWASV measurements in which mercury ions present in the electrolyte are pre-concentrated onto the electrode surface. Initial results show increased sensitivity with BDD electrodes decorated with smaller gold nanoparticles (<15 nm).

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Synthesis and characterization of a nanostructured lamellar vanadium disulfide / carbon hybrid material

Jaehoon Choi[1,2,3], Pattarachai Srimuk[1,2], Juhan Lee[1,2], Volker Presser[1,2]

[1]INM - Leibniz Institute for New Materials, 66123 Saarbrücken, Germany
[2]Department of Materials Science and Engineering, Saarland University, 66123 Saarbrücken, Germany
[3]School of Energy, Materials, and Chemical Engineering, Korea University of Technology and Education, 1600 Chungjeol-ro, Cheonan 31253, Republic of Korea

Transition metal dichalcogenides (TMDs) are two-dimensional materials with a layered structure like graphite. TMDs like MoS2, MoSe2, WS2, WSe2, or TiS2 have attracted considerable research attention due to their variable electronic properties and nanolamellar structure. Furthermore, TMDs exhibit attractive electrochemical properties, particularly, for applications like electro-catalysts, batteries, and microelectronics. However, not all TMDs have sufficient electrical conductivity required for such applications. Therefore, hybridizing TMDs with carbon is a promising route to obtain electrodes with enhanced electrical conductivity Among TMD materials, vanadium disulfide shows weak interlayer van der Waals force leading to loosely stack layers. For the synthesis of vanadium disulfide, several methods have been established, such as solvothermal, solid state reaction, and chemical vapor deposition. Our work explores the synthesis of vanadium disulfide / carbon hybrid materials (Fig. 1) and introduces an array of material characterizations for the structure of the materials.

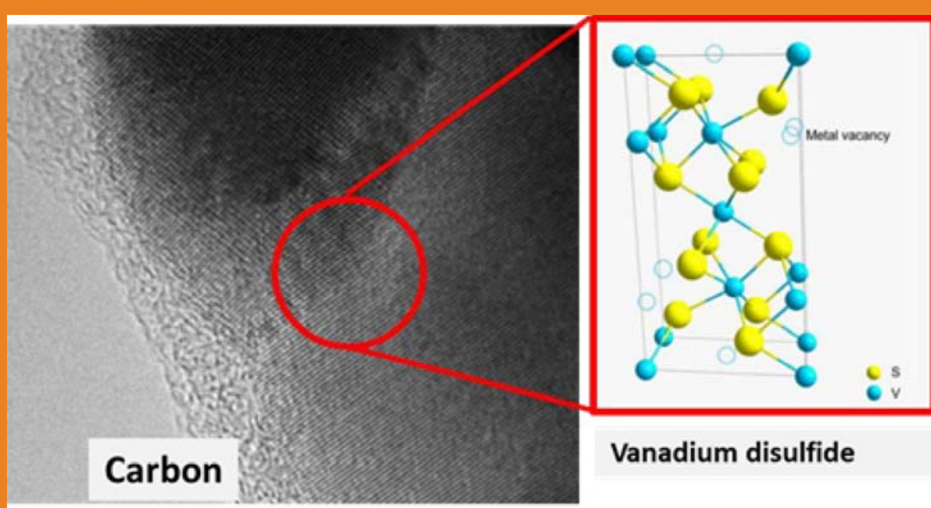

Figure 1: Morphology and structure of a vanadium disulfide / carbon hybrid material.

Enhancing the Mechanical Durability of Icephobic Surfaces by Introducing Autonomous Self-Healing Function*

Yizhi Zhuo, Verner Håkonsen, Zhiwei He, Senbo Xiao, Jianying He* and Zhiliang Zhang**

NTNU Nanomechanical Lab, Department of Structural Engineering, Norwegian University of Science and Technology (NTNU), Trondheim 7491, Norway.

**jianying.he@ntnu.no; zhiliang.zhang@ntnu.no

Ice accretion presents a severe risk for human safety. Although great efforts have been made for developing icephobic surfaces (the surface with an ice adhesion strength below 100 kPa), expanding the lifetime of state-of-the-art icephobic surfaces still remains a critical unsolved issue. Herein, a novel icephobic material is designed by integrating an interpenetrating polymer network (IPN) into an autonomous self-healing elastomer, which is applied in anti-icing for enhancing the mechanical durability. The molecular structure, surface morphology, mechanical properties, and durable icephobicity of the material were studied. The creep behaviors of the new icephobic material, which were absent in most relevant studies on self-healing materials, were also investigated in this work. Significantly, the material showed great potentials for anti-icing applications with an ultralow ice adhesion strength of 6.0±0.9 kPa, outperforming many other icephobic surfaces. The material also exhibited an extraordinary durability, showing a very low long-term ice adhesion strength of ~12.2 kPa after 50 icing/deicing cycles. Most importantly, the material was able to exhibit a self-healing property from mechanical damages in a sufficiently short time, which shed light on the longevity of icephobic surfaces in practical applications.

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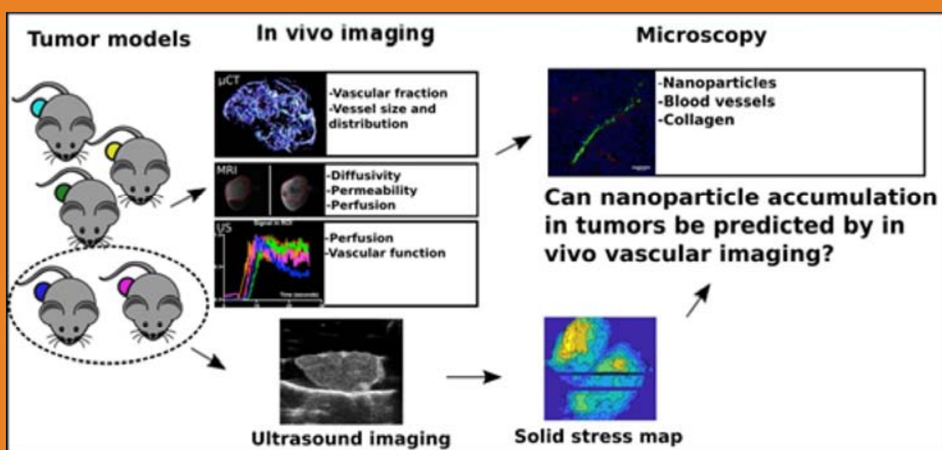
Delivery of macromolecules and nanoparticles to solid tumors

Einar Sulheim

NTNU Dep. Physics / SINTEF Biotechnology and Nanomedicine

Drug delivery using nanoparticles or macromolecules is a promising approach to avoid the non-specific distribution of conventional cancer drugs. In addition a range of new drugs such can be delivered using nanomedicines. However, due to their size, multiple obstacles hampers efficient delivery of nanomedicines. These are especially the endothelial cells lining the blood vessels and the extracellular matrix consisting of fibroblast and macromolecules such as collagen and hyaluronic acid. In addition, solid stress, caused by the extensive growth of both tumor cells and stroma, can cause blood vessels to collapse and leave areas inaccesible to drugs.

In my talk I will discuss how imaging of the vasculature can be used to predict nanomedicine accumulation and how te above mentioned properties must be evaluated to select patients for nanomedicine therapy. I will also discuss how therapeutic ultrasound treatment can help in overcoming some of these biological barriers.



Determination of silver nanoparticle stability via stimuli-induced heating

Lukas Steinmetz[1], Christoph Geers[1], Laura Rodriguez-Lorenzo[1], Mathias Bonmarin[2], Sandor Balog[1], Barbara Rothen-Rutishauser[1], Alke Petri-Fink[1,3]

[1]Adolphe Merkle Institute, Chemin des Verdiers 4, Fribourg, Switzerland
[2]Institute of Computational Physics, Zurich University of Applied Sciences, Technikumstrasse 9, 8400 Winterthur, Switzerland
[3]University of Fribourg – Chemistry Department, Chemin du Musée 9, Fribourg, Switzerland

lukas.steinmetz@unifr.ch

Silver nanoparticles (Ag NPs) are one of the most frequently used nanoparticle types in consumer products, such as textiles and cosmetics, which inevitably leads to their emission into wastewater and other aquatic systems. Therefore, their behavior in natural environments and biological fate have to be carefully studied in order to fully understand NP accumulation & transformation along their discharge pathways [1].

As all NPs can potentially end up in complex environments or even be uptaken by organisms, standard analytical methods, such as electron microscopy (EM), static or dynamic light scattering (SLS, DLS), or X-ray diffraction can deliver precise results, but are prone to artifacts and usually require expert knowledge for data treatment. Additionally sample preparation or measurements are often time consuming [2].

Hence, we were looking for a reproducible, nondestructive measurement method with high precision and accuracy to investigate Ag NPs' fate in realistic, i.e. acidic, oxidizing and biologically relevant environments.

We stimulated Ag NPs with a homogeneous light source and measured the heat generated by these plasmonic NPs. The thermal signal was detected with lock-in thermography (LIT) [3], an ultra-sensitive infrared imaging technique, commonly used to test composites and electronic components (e.g. solar panels) [4].

The result is a 2D heat map, which allows quantifying the produced heat with respect to the applied light intensity. The method has been successfully applied to rapidly and efficiently test and compare the stability of Ag NPs in different media and over the course of 24 hours at room temperature and 37 °C.

Consequently, a decrease in heat generation can be attributed to either nanoparticle dissolution or aggregation.

In addition to LIT, we employed UV-Vis spectroscopy, DLS, TEM and small angle x-ray scattering (SAXS) as complementary methods to analyze the Ag NPs under identical conditions. Depending on the media we were able to observe different behavior of Ag NPs via LIT, e.g. NPs were stable in cell culture medium, while a distinct reduction of particle heat generation was detected over 24 hours for acidic and oxidizing conditions.

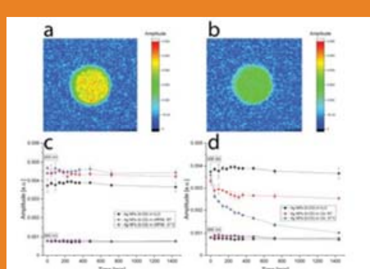


Figure 1. 2D LIT heat signal of 30nm Ag NP dispersions in cRPMI (a) and citric acid (b) after 24 hours. NP amplitude signal of 30nm Ag NPs in cRPMI (c) and citric acid (d) over 24 hours for two different wavelengths and temperatures.

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Biofunctionalized gold nanoparticles as novel anti-virals against Enteroviruses

Dhanik Reshamwala[1], Antonella Zacheo[2], Sailee Shroff[1], Silke Krol[2,3] and Varpu Marjomaki[1]

[1]Department of Biological and Environmental Science, Nanoscience Center, University of Jyväskylä, Finland
[2] IRCCS Istituto Tumori "Giovanni Paolo II", Bari, Italy
[3] Fondazione IRCCS Istituto Neurologico "Carlo Besta", Milan, Italy

Enteroviruses can evade host immune system and cause an array of diseases ranging from common cold to more serious acute and chronic infections. Enteroviruses can lead to inflammations in the myocardium, brain and pancreas resulting in atherosclerosis and myocardial infarction [1]. Recent evidence suggests that many species-B enteroviruses (EV-B) are associated with type I diabetes [2, 3]. So, it is imperative to encounter these viruses using vaccines and anti-virals. Currently there are no vaccines available against enteroviruses, except for poliovirus. However, vaccines cannot help if the infection is already present in the system. In addition, non-enveloped viruses like enteroviruses are resistant to chemical disinfectants. Also, none of the traditional drugs have made it past the clinical phase. So, currently, no antiviral therapy is available for enterovirus infections. Therefore, it is imperative to explore other alternatives for encountering these viruses. Here, we report the use of biofunctionalized gold nanoparticles (Bf-AuNPs) as an alternative to traditional antivirals against enteroviruses. The Bf-AuNPs synthesized using green chemistry, were not cytotoxic to A549 cells. Bf-AuNPs screened for their anti-viral efficacy using cytopathic inhibitory assay, were successful in protecting the A549 cells against coxsackievirus B1 (CVB1) and coxsackievirus B3 (CVB3) infection. Transmission electron microscopy (TEM) imaging was performed to evaluate the direct effect of these nanoparticles on viruses. In addition, real-time spectroscopy analysis was also performed to investigate the effect of BfAuNPs on the uncoating and genome release of the virus. Based on our preliminary findings, we introduce Bf-AuNPs as novel anti-virals against enteroviruses.

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