CINSaT Center for Interdisciplinary Nanostructure Science and Technology

Newsletter No. 13 (December 2022)

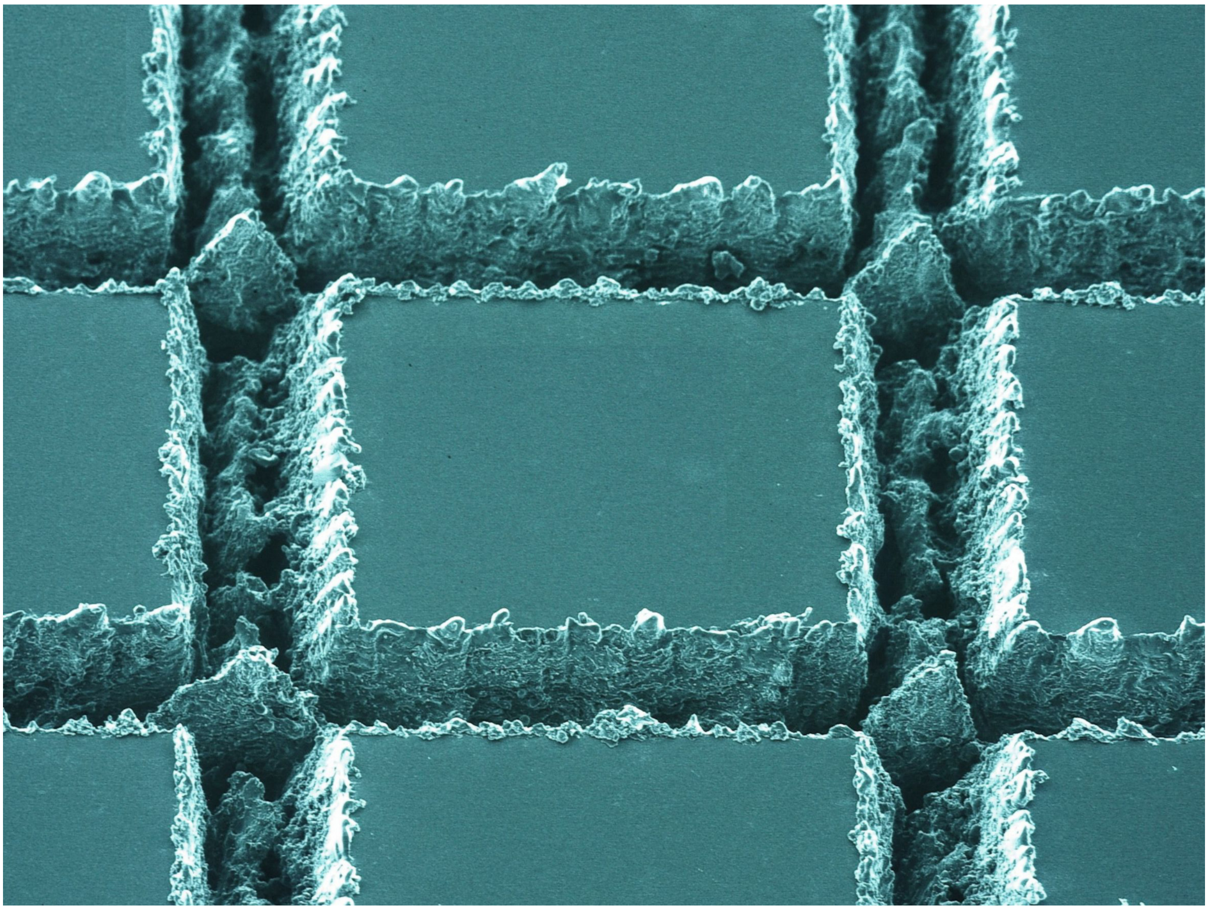

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Table of contents

Cover Image

Silicon wafer cut by laser (beamsize 100 mikrometer) and afterwards coated with ultrananocrystalline diamond (UNCD). The laser cut from intersection to intersection resulting in pyramides at the crossroads.
(Dr. Daniel Merker)

Preface

Dear reader,

welcome to the second issue of the CINSaT newsletter in 2022. At the end of the year one can reflect on everything that happened. This year we could celebrate the 20th anniversary of the CINSaT with an international workshop with participants from over 20 countries. A detailed report you can find in the last newsletter (1/2022). Additionally, in the wake of the workshop a commemorative publication was created with over 200 pages that outlines the history of the CINSaT since 2002, shows the development over the last 20 years and highlights the current activities of all CINSaT members. The publication is now available on the CINSaT website.

The CINSaT autumn colloquium was the last event of the year and was carried out successfully on Wednesday, the 2nd of November. The colloquium was very well received with four external speakers, over 120 registered participants and a peak audience of ca. 150. With over 60 poster contributions more posters were showed than ever before. A more detailed report about the colloquium, the guest speakers, and their talks as well as the winners of the poster awards you can find in the Latest Reports section.

But mainly the content of the newsletter is as usual provided by contributions of our CINSaT member groups. In the New Projects section Prof. Cyril Popov introduces us to his new BMBF project “Competitive German Quantum Computer” (CoGeQ) about the creation of a mobile quantum processor. The project is realized in collaboration with the University of Leipzig, University of Ulm, and the companies CiS GmbH and SaxonQ GmbH, combining academia and industry. Prof. Peter Lehmann and Prof. Hartmut Hillmer are reporting about recent developments in their joint DFG-funded project about the production of specific 3D nanoparticles and nanostructures for the development of an automated optical characterization using high-resolution interference microscopy.

In the Research Highlights section Prof. Raffael Schaffrath presents a recent publication titled “E2/E3-independet ubiquitin-like protein conjugation by Urm1 is directly coupled to cysteine persulfidation” in collaboration with researchers from the University of Bern and University of Krakow. The publication gives insight into the role of the ancient protein Urm-1 which plays an important role in many biological processes as a sulfur carrier protein. Prof. Hartmut Hillmer, in collaboration with Prof. Stefan Buhmann who provided calculations, report about the development progress of a novel method for 3D self-assembling of microstructured shutter and mirror arrays utilizing the quantum electrodynamic Casimir force.

Prof. Claudia Backes introduces herself and her research work about 2-dimensinal nanomaterials in the New Members section, after joining CINSaT successfully in April of this year as a full member.

Like always, I hope you enjoy the reading of this issue and stay healthy!

Research Highlights

Urm1, a sulfur carrier par excellence – ubiquitin-like urmylation is coupled to sulfur transfer and cysteine persulfidation

Posttranslational protein modifications are essential for life. Cysteine persulfidation is a reversible modification with emerging roles in biological processes like aging. The ancient protein Urm1 might function in directed persulfidation of specific redox-active cysteines.

Since its discovery in 2000 by Nobel Prize laureate Professor OHSUMI, the small eukaryotic protein Urm1 (ubiquitin related modifier 1) has remained an enigma in the life sciences. Although Urm1 shares high sequence similarity with prokaryotic sulfur carrier proteins (SCP), it was initially found to conjugate to target proteins posttranslationally. Such function, however, was only known from the eukaryotic protein ubiquitin and ubiquitin-like proteins (UBL) to which Urm1 was then assigned. Continuous studies revealed that Urm1 has a second function. As a matter of fact, it plays a key role as an SCP in the thiomodification of tRNA anticodons. In general, anticodon modifications are necessary for proper mRNA translation and protein synthesis, and malfunctions associate with human diseases, including cancer and neurodegeneration. Whereas the latter tRNA thiolation function of Urm1 had been established, the molecular mechanisms of its attachment to target proteins remained largely unknown.

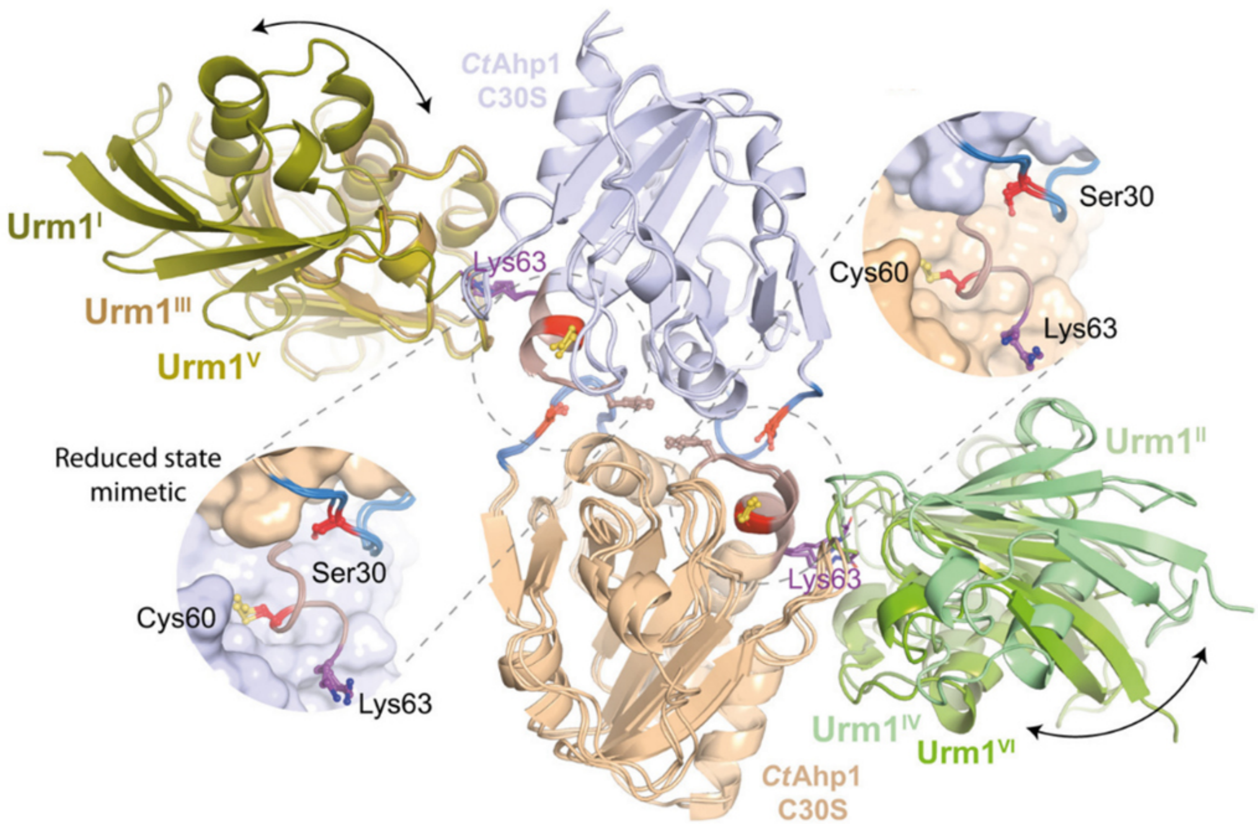

Fig. 1: Structure of the urmylated Ahp1 complex.

Front view of the $CtAhp1_{C30S}$-$CtUrm1_{C55S}$ complex structure in cartoon representation. All three entities in the asymmetric unit are superimposed on Ahp1 and the various Urm1 molecules are labeled. The position of Lys63 (violet) is highlighted and labeled. Insets: Close-up of the active sites highlighting the position of the redox-active cysteines (Cys60 and Ser30 in red).

Interestingly, SCP as well as UBL share a common three-dimensional fold, the β-grasp fold and are activated in a similar manner to fulfill their functions. Activation of Urm1 is special as it requires sulfur-transfer onto its C-terminal carboxyl group (-COOH), a step thought to be typically restricted to prokaryotic SCP. The resulting thiocarboxylate (-COSH) in Urm1 and all SCP is essential for subsequent thiolation reactions including Urm1-dependent tRNA thiomodification (see above).

Protein modification cascades of ubiquitin and UBL typically involve specific enzymes called E1, E2 and E3. Urm1 conjugation (aka urmylation) is best studied with yeast peroxiredoxin Ahp1, an antioxidant enzyme reducing organic hydroperoxides via redox-active cysteine residues. However, no E2 or E3 enzymes are known so far for Ahp1 urmylation to occur and neither the role nor the fate of the sulfur within the unique -COSH moiety (see above) have been identified during or upon urmylation.

In our recent collaboration, which was jointly published in *EMBO J* (2022, **41**: e111318) by members of the laboratories of Professor Sebastian LEIDEL (University of Bern, Switzerland), Professor Raffael SCHAFFARATH (University of Kassel) and Dr hab. Sebastian GLATT (University of Krakow, Poland), we found that the conjugation of Urm1 is accompanied by the transfer of sulfur to cysteine residues in the target proteins also known as cysteine persulfidation (-S-SH). The data emphasize that both functions of Urm1, i.e., protein urmylation & tRNA thiolation, do involve sulfur transfer onto biomolecules reminiscent of the thiolation functions of prokaryotic SCP (see above). We further showed that thiocarboxylated Urm1 can conjugate to Ahp1 *in vitro* under conditions of mild oxidative stress and importantly, without any requirement for E2 or E3 enzymes (see above). This urmylation reaction depends on the -COSH moiety of Urm1 and a conserved redox-active cysteine in Ahp1. Ultimately, Urm1 is preferably linked to lysine residues in Ahp1 by an isopeptide bond or to a lesser extent to serine and threonine residues by ester bonds.

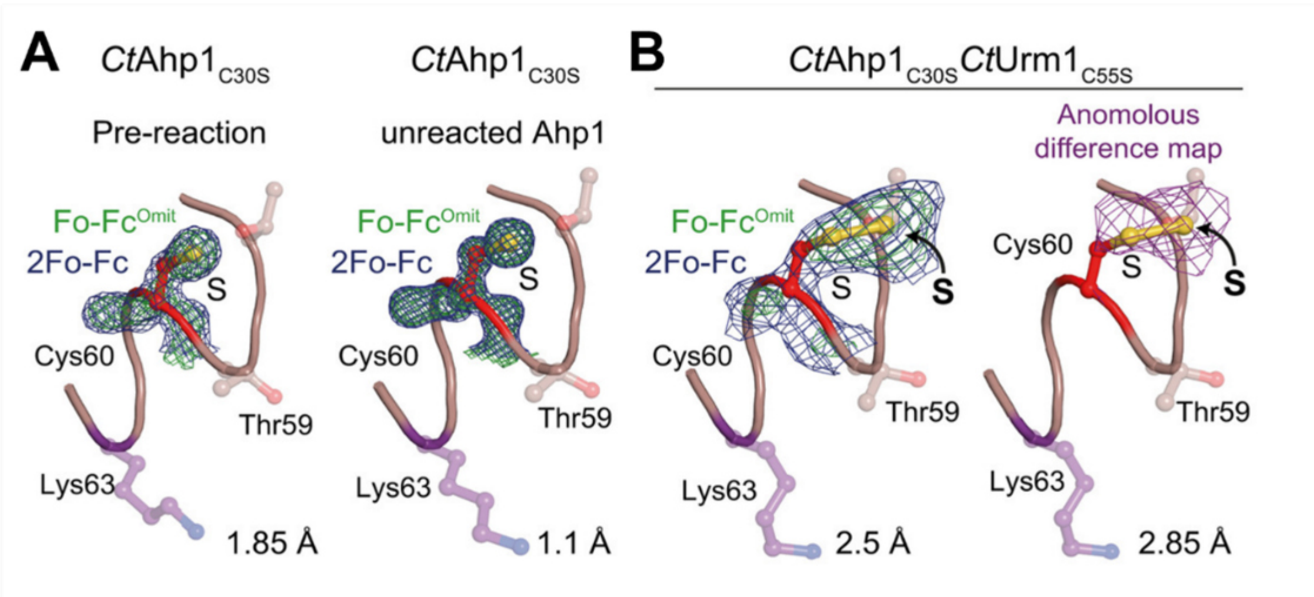

Fig. 2: Urm1 conjugation directly mediates cysteine persulfidation in vitro.

A. Structural close-up of the peroxidatic cysteine (Cys60) and Lys63 (violet) in CtAhp1$_{C30S}$ pre-conjugation (left) and unreacted Ahp1 from the conjugation reaction (right). The refined 2Fo-Fc density (blue) and the Fo-Fc omit map lacking the active site cysteine (green) is shown at comparable σ-levels. B. Same view as in A of the maps in the CtAhp1$_{C30S}$-CtUrm1$_{C55S}$ complex around Cys60 (red) at 3.5 σ (blue, left), 4 σ (green, left) and the anomalous difference Fourier map at 2 σ (violet, right). The respective resolution ranges of the maps are indicated.

Using protein sequences from *Chaetomium thermophilum*, a thermophilic fungus harboring highly stable proteins, we determined (*EMBO J*, 41: e111318) the structure of the urmylated Ahp1 complex by macromolecular crystallography (Fig. 1). The asymmetric unit contained three individual Ahp1-Urm1 dimers, which were all linked via the same isopeptide bond between the Lys63 sidechain of Ahp1 and the Urm1 C-terminus (Fig. 1). This conformational variation might result from the fact that Ahp1 and the attached Urm1 do not form an extensive interaction surface. Mass spectrometry analyses of the conjugation products revealed that additional lysine residues as well as serine and threonine residues can act as alternative attachment sites for Urm1.

Intriguingly, the sulfur atom from the Urm1 thiocarboxylate was not detectable at the site of linkage in our mass spectrometry analyses. Reanalysis of the crystallographic data showed a prominent density next to the sulfur atom of the cysteine redox active side chain in the crystal structure of the Ahp1-Urm1 complex, which was absent from individual Ahp1 structures alone (Fig. 2A). Calculation of anomalous difference Fourier maps confirmed that persulfidation of the Ahp1 cysteine side chain (-S-SH) only occurred during the conjugation with the Urm1 thiocarboxylate (Fig. 2B).

Our results reveal a novel and surprising link between ubiquitin-like conjugation of Urm1 and posttranslational cysteine persulfidation of its target proteins.

Further information

Ravichandran KE, Kaduhr L, Skupień-Rabian B, Shvetsova E, Sokołowski M, Krutyhołowa R, Kwasana D, Brachmann C, Lin S, Perez SG, Wilk P, Kösters M, Grudnik P, Jankowska U, Leidel SA, Schaffrath R, Glatt S (2022) E2/E3 independent ubiquitin-like conjugation by Urm1 is directly coupled to cysteine persulfidation. *EMBO J* **41**: e111318.
PMID: 36102610
doi: 10.15252/embj.2022111318

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Development of a 3D Self-assembly method using Casimir Forces

Utilizing our platform technology of MEMS micro shutter/mirror arrays [1], we have developed a novel method for the 3D self-assembling of microstructures under specific modifications of the fabrication process. The method is based on the dynamic process of pairing of neighbouring MEMS shutter blades representing a highly nonlinear Casimir system. In cooperation with the working group Macroscopic Quantum Electrodynamics (Prof. Buhmann) recent calculations have shown that the Casimir force would be strong enough for keeping the two blades attached to each other [2]. Furthermore, we studied the influence of the drying angle on the shutter pairing within the fabrication process [3]. The latest experiments were focussed on geometrical aspects of the paired shutter blades (curling and influence of interface roughness).

In 1948, H. B. G. Casimir postulated the quantum electrodynamic Casimir effect [4] which is describing attractive forces between two perfectly conducting plates in vacuum. These forces are based on the difference in zero-point energies inside and outside the cavity leading to a total radiation pressure towards the plates (see Fig. 1). Since then, much research has been done in this field. In the research group of Macroscopic QED (Prof. Buhmann), the interaction of light with microscopic and macroscopic materials (here: metals) is studied by means of QED including the phenomenon of Casimir (dispersion) forces.

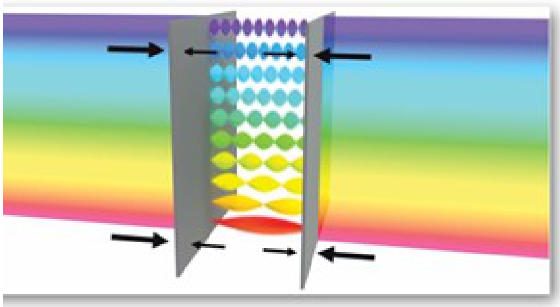

Fig. 1: Schematic of the attracting net force arising between two uncharged conducting plates.

The Casimir force shows a strong nonlinearity regarding the distance d of the two plates, which ranges between d^{-3} and d^{-4}. That means, for very close objects e.g., microstructures it plays a significant role. In this research, we use what is often considered as an undesired stiction to self-assemble (two) metallic MEMS blades into arrays of asymmetric hollow cylinders/tubes. Ones they have been paired and the two shutter blades are sticking together it is extremely difficult to separate them again. Thus, this system provides the possibility to obtain a unique 3D structure and further study the Casimir forces between to metallic blades.

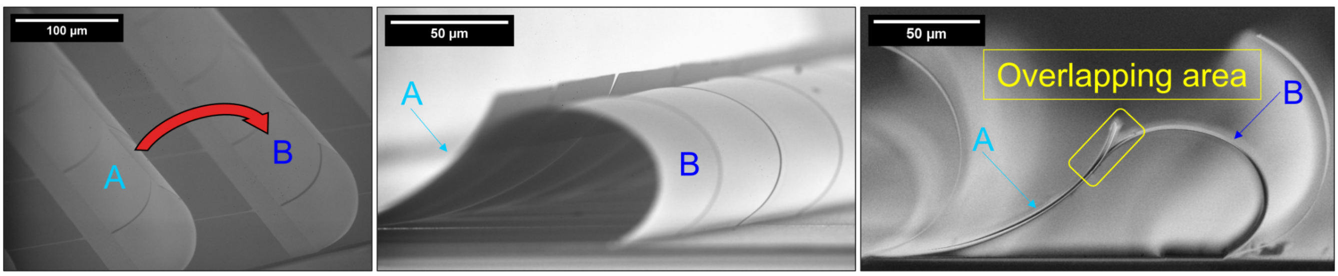

Fig. 2: Scanning electron micrographs of (left) free-standing MEMS shutter blades, (middle) paired shutters and (right) side view illustrating the cross section. During drying process, shutter A snaps down catching shutter B forming a permanent Casimir system in the overlapping area.

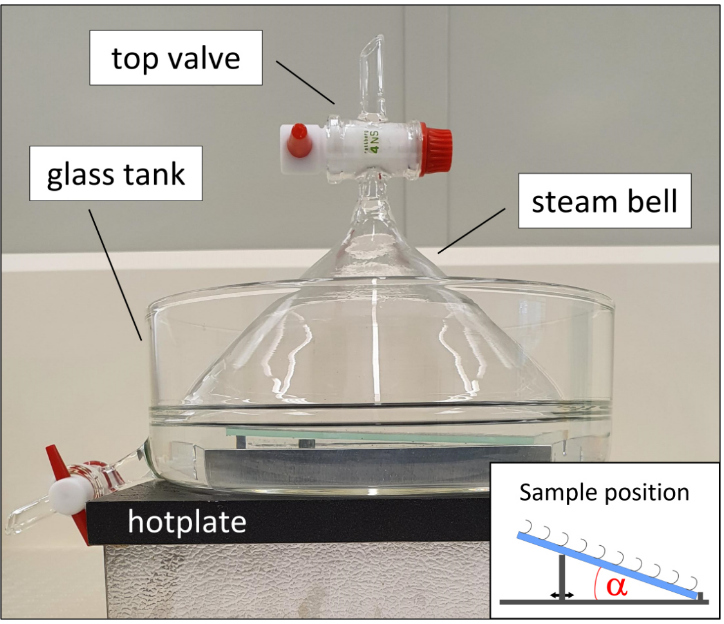

Fig. 3: Drying process of the MEMS shutter blade sample using an isopropanol steam bell. The anchor stripe of each shutter is showing upwards, and the sample is (slightly) tilted allowing the gradual solvent drying on the sample's surface. Further information in [3].

On the substrate our free-standing micro shutters are periodically arranged in a (2D) array (Fig. 2 left). Each element is fixed to the substrate through an anchor stripe and curled due to intrinsic stress in the thin film layer system consisting of Aluminium and Chromium. If two shutters of neighbouring rows (Shutter A and B) get in contact (indicated by the red arrow in Fig. 2), they can form a permanent shutter-pair (Fig. 2 middle). Figure 2 (right) shows the cross-section of a paired shutter in comparison to curled unpaired elements.

Based on the evaluations of the experiments for paired and unpaired cases, a relatively large technological process window for pairing (3D self-assembly of shutter blades) has been identified revealing significant dependence on how the drying process is carried out. In Fig. 3 the drying setup is depicted. The sample is dried on a hotplate using an isopropanol steam bell which is built by a combination of a glass tank with a drain valve and a steam bell with a smaller diameter than the tank. The steam bell is keeping an isopropanol atmosphere during the whole process. The sample is fixed on an aluminium mount with adjustable tilt angle inside the steam bell. The anchor stripes of the micro shutters are always directed upwards (see inlet Fig. 3). The drying set up is enabling the gradual movement of the isopropanol thin film on the sample's surface (row by row). This allows shutter A to snap back - acting like a spring - meanwhile,

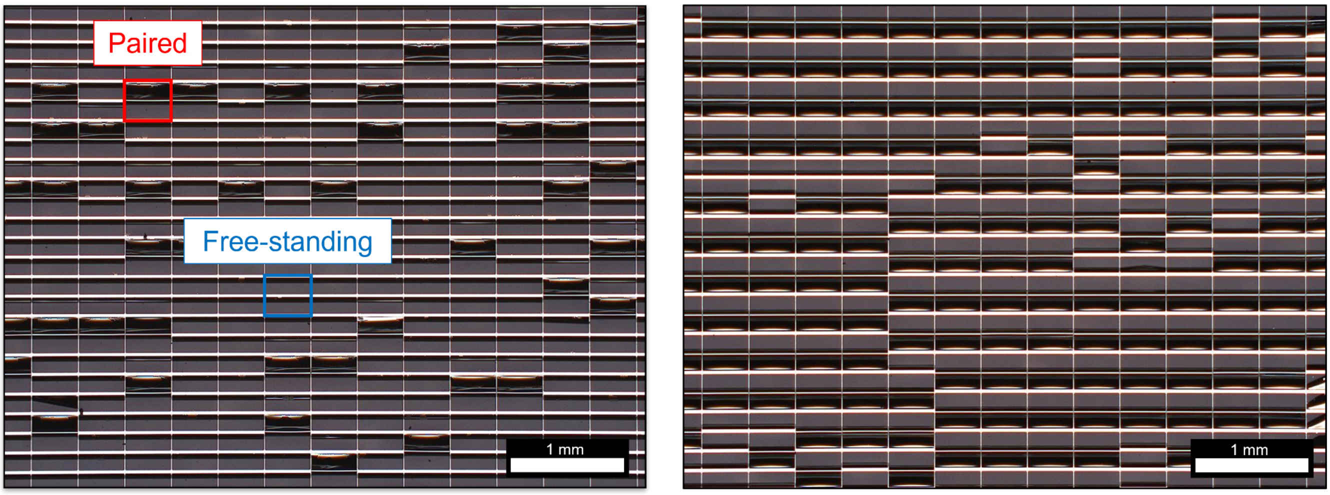

Fig. 4: Comparison of paired shutter yield by arbitrarily chosen cut-outs on two samples dried under a tilt angle of α = 1° (left) to α = 40° (right).

shutter B is still in the initial curling state. The combination of shutter B's initial curling state and shutter A's movement determines whether the shutter blades will pair or not.

The 3D self-assembly pairing is a highly complex, non-linear, and dynamic process. For better understanding it is captured in the video accessible through the QR code.

For quantification of the dependence of the sample's orientation on the occurrence of paired shutters, the yield is calculated as the ratio of observed paired shutters to the maximum possible number of paired shutters within an investigated area (Figure 4) [3]. We found that the tilt angle of the sample during the drying process clearly influences the yield of paired shutters with an ideal solvent flow in the diagonal range of around $\alpha = 45°$. This is also in accordance with the video ($\alpha = 25°$).

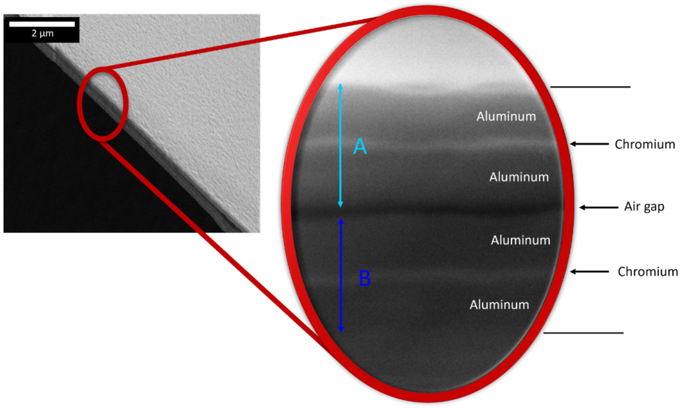

Fig. 5: Overlapping area of the two paired shutter blades A and B. The inlet shows the cross section of the metal layer system of both shutters and the small air gap inbetween.

The pairing of two shutter elements is initiated by surface tension forces of the isopropanol but our studies indicate that the Casimir forces is most probably the reason for keeping both shutters permanently together. Our simulations estimated a distance of ≤°22°nm to be necessary to attach two shutter blades by Casimir forces. This is consistent with our SEM micrographs showing a distance of about 10 nm or less [2].

The calculation is based on the cross section assuming ideal smooth surfaces of the metallic shutter blades of the overlapping area (Figure 5). In an upcoming investigation, this is expanded to 2D real surface profiles evaluating the vertical as well as lateral force components with respect to the plates plane.

Our latest investigations were focussed on the variation of the shutter element geometries initiated by changes in the metal layer system. In this way net intrinsic stress within the hybrid metal layer stack is utilised to generate different types of paired shutters. An example is given in Fig. 6. The paired as well as the unpaired shutters show different cross sections when the top

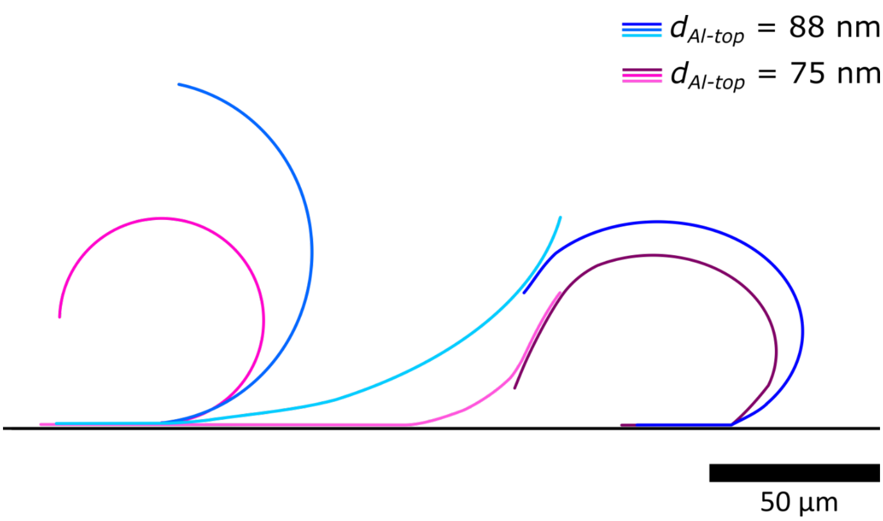

Fig. 6: Illustration of the side view of free-standing and paired MEMS shutter blades for two top metal layer thicknesses. The shutter element geometries are strongly dependent on the metal layer thickness.

Aluminium layer is thinned. Further decreasing of this layer thickness is resulting in completely rolled-up tubes which are not able to pair anymore.

Future investigations are planned to establish an improved fabrication process window for stable control of 3D self-assembling of shutter geometries. For this purpose, not only the fabrication process shall be analysed but also new geometries introduced by changes in the optical lithography photo mask. The gained experimental data might be used for improving shutter simulations to precisely describe the experimental results. After all, the experience can be used to understand and overcome stiction issues in MEMS technology or the opposite: to use it in 3D self-assembly of MEMS structures.

Further information

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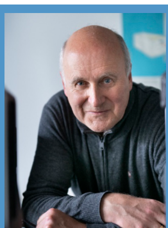
Our ‘Casimir’ group from left to the right: Roland Donatiello, Nagajyothi Gundu, Eireen Käkel, Prof. Dr. Hartmut Hillmer, Phillip Kästner, Basma Elsaka and Xiaohui Yang. Missing: Kara Darwish.



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New Projects

BMBF Research Project: Competitive German Quantum Computer (CoGeQ)

Quantum computers will allow an enormous rise of the computing power compared to the classical computers. However, all approaches in the development of such computers up to now are based on techniques which can be realized only with large infrastructural efforts, for example complex cooling technology, and do not allow compact and highly integrated systems. A novel approach implementing a solid-state spin-based architecture in synthetic diamond offers the principal advantage that it can be operated at room temperature and allows the construction of a compact quantum computer less demanding on the surrounding infrastructure (e.g., cooling).

The goal of the BMBF project CoGeQ is the realization of a mobile gate-based quantum processor consisting of NV color centers. These point defects in the diamond crystal are composed of a nitrogen atom in the diamond lattice adjacent to a vacancy, i.e. an empty site in the lattice. The NV color centers resemble artificial atoms and act as qubits. In order to bring the NV centers into controlled quantum mechanical interaction with each other for a processor performance, they must be placed deterministically very close to each other. This has to be achieved in the project with a novel, much more efficient implantation method, which should make the scaling up to higher qubit numbers easier. A successful realization of the project will lay the foundation of a highly integrated system that could be integrated into CMOS platforms for classical computers and could be manufactured as a hybrid system for realization of a compact mobile quantum computer.

The Federal Ministry of Education and Research (BMBF) is funding the project CoGeQ with about 4.24 million euros over the next three years. The project is coordinated by Prof. Jan Meijer, University of Leipzig, further partners are University of Kassel, University of Ulm, CiS Forschungsinstitut für Mikrosensorik GmbH, Erfurt and SaxonQ GmbH, Leipzig. The group of apl. Prof. Cyril Popov at the University of Kassel will contribute to the project in the field of diamond nanotechnology, including the preparation of the samples for implantation, their surface modification and nanostructuring with nanopillars for enhancement of photon collection efficiency.

Further information
https://www.quantentechnologien.de/forschung/foerderung/quantencomputer-demonstrationsaufbauten/cogeq.html

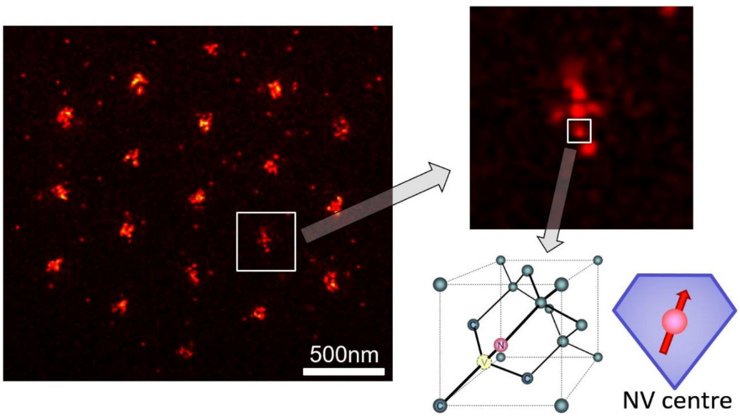

Fig. 1: Fluorescence from small ensembles of NV centers created by implantation in diamond

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Joint DFG Project, 2nd period: Production of specific 3D nano-particles and nano-structures for the development of an automated optical characterization using high-resolution interference microscopy

In this joint research project of the Institute for Nanostructure Technology and Analytics (INA, Prof. Dr. Hartmut Hillmer) and the Measurement Technology Group (Faculty of Electrical Engineering and Computer Science, Prof. Dr. Peter Lehmann), production and interferometric characterization methods for curved surfaces structured in the micro- and nanometer range will be developed. The structures are produced using nanoimprint lithography (NIL) and characterized based on Linnik coherence scanning interferometers (CSI). The project aims to expand the NIL process regarding the variety of shapes and materials to complex 3D structures. In addition, a non-contact but high-resolution measurement method will be established, which is capable of measuring these complex geometries. Both, measurement setup and methodology will be tested by measuring defined geometries and materials.

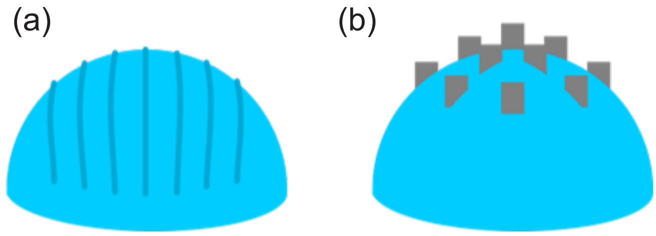

Fig. 1: Schematic representation of the 3D structures to be manufactured using the SCIL process. Here, substructures made of polymer (a) and metal (b) are applied to the hemispheres made of PDMS.

The production of hemispherical structures using isotropic dry etching has already been demonstrated. Furthermore, a NIL process to produce 3D metal structures through precise multiple imprinting was established. To characterize the structures, an adaptive measurement concept based on a Linnik interferometer was developed and implemented. Using a reference object with a geometry that is adapted to the geometry of the measuring object, form deviations in the nanometer range can be measured. These can be accessed and evaluated using in-house developed signal processing algorithms.

The current research connects directly to the results already achieved in the first period of DFG funding. Via substrate conformal nanoimprint lithography (SCIL), metal structures are supposed to be fabricated on top of hemispherical polymer structures (Fig. 1). On the one hand, this is aimed at the production of hybrid material structures, on the other hand, a sub-

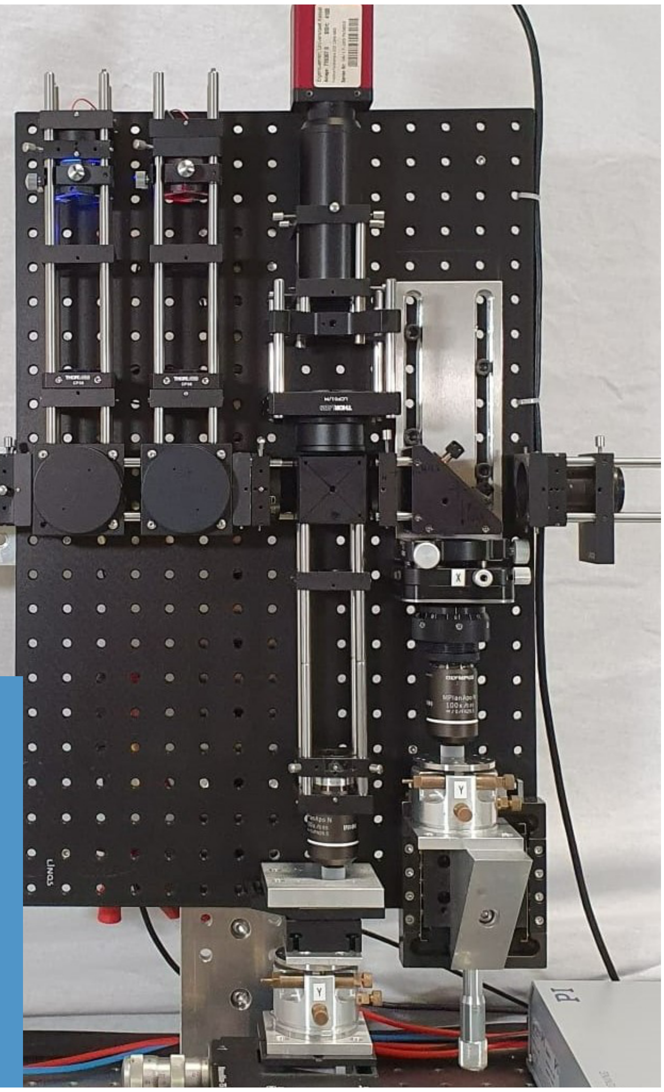

Fig. 2: Linnik-CSI setup with two 100x objective lenses with an NA of 0.95 and a sttructured annular illumination arm including LED light soruces of different color.

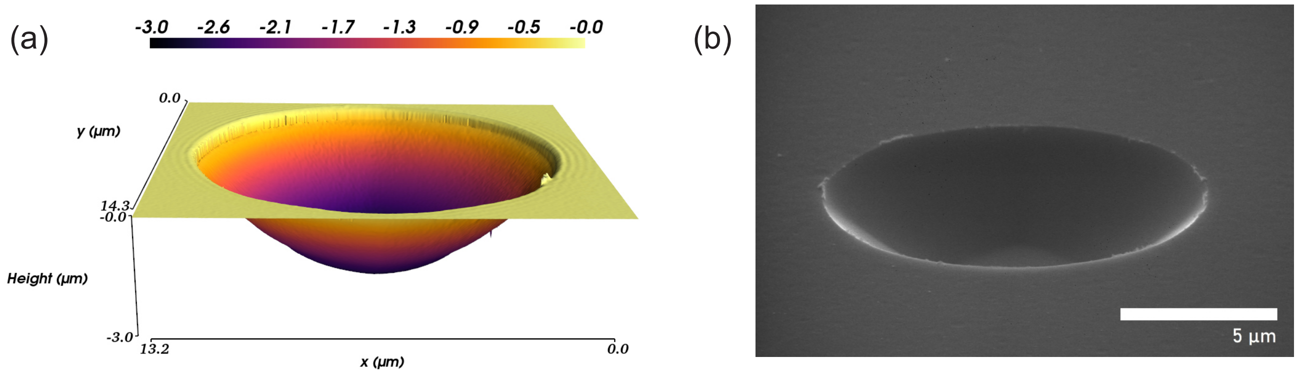

Fig. 3: Measurement results of an etched concave structure achieved with the Linnik-CSI setup mentioned above, a) 3D-reconstruction of the measured surface, b) SEM image of a similar but larger structure for comparison.

structuring can take place by NIL on curved surfaces and thus opens up new paths towards geometrically demanding structures. The focus of the fabrication process will i. a. be on a special SCIL stamp that prevents the residual layer from curing during the imprint process.

The measurement of differently scaled parts of a single structure and the combination of different materials impose high demands on the interferometric measurement system. Within the scope of this project, the adaptive measurement concept is to be extended and transferred to a larger number of sample geometries and scales.

One focus of the research is the acquisition of reliable measurement data at steep surface slopes. For this purpose, objective lenses with an NA of 0.95 and 100x magnification are used in the Linnik-CSI setup shown in Fig 2. In combination with a new type of structured annular illumination, it is possible to measure surfaces with significantly steeper slopes compared to conventional illumination.

Figure 3a shows the measurement result of an etched concave structure obtained with the annular illumination. Apart from minor artefacts appearing at the steepest slope angles of more than 60°, the surface could be completely reconstructed, which was

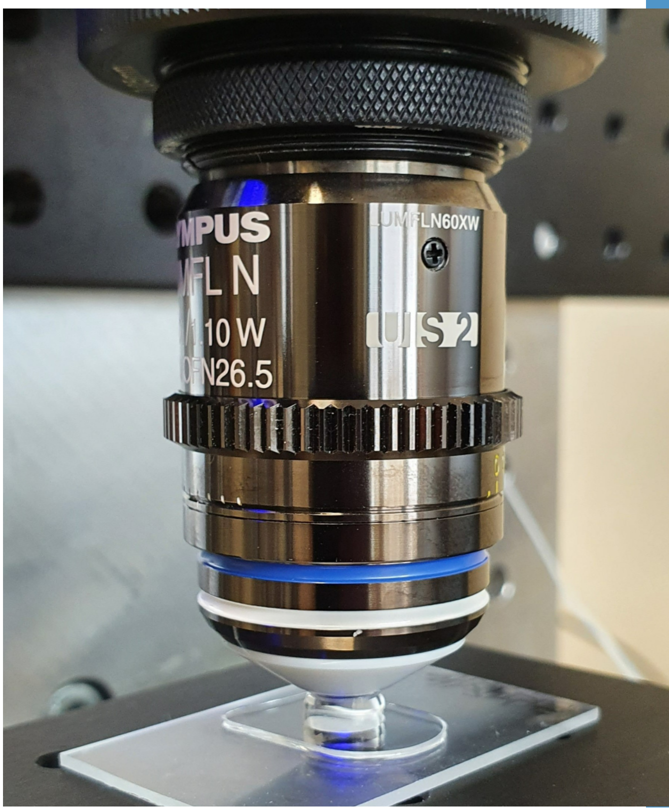

Fig. 4: Water immersion objective lens with an NA of 1.1 increasing the lateral resolution.

not possible with the same interference microscope but using conventional Köhler illumination. For comparison, Figure 3b shows an SEM image of the concave structure.

Another focus of research lies on the integration of water immersion objective lenses with an NA of 1.1 and 60x magnification in an interferometer system. These provide the opportunity to increase the lateral resolution of the system to about 200 nm but require the consideration of effects of the immersion media on the measured interference signals. Additionally, the system is supposed to be upgraded in order to benefit from polarization dependent effects even under UV-illumination.

Further information

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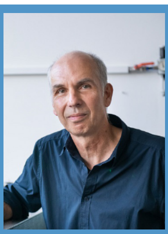

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New Members
Prof. Dr. Claudia Backes

Prof. Claudia Backes was appointed to the Chair of Physical Chemistry of Nanomaterials at Kassel University in October 2021. She became member of the CINSat in spring 2022.

Claudia studied Molecular Nano Science at the University of Erlangen and received her Ph.D with honors in 2011 on her work on the solubilisation of single-walled carbon nanotubes. From 2011-2012, she remained in Erlangen and supported the Erlangen Cluster of Excellence “Engineering of Advanced Materials” as deputy executive director and scientific coordinator. After receiving a fellowship grant from the German Research Foundation (DFG) in 2012, she moved to Jonathan Coleman’s groups at Trinity College Dublin, Ireland. Shortly after returning to Germany in 2015, she was awarded with the prestigious Emmy Noether funding from the German Research Foundation to establish her own independent research group at the Chair of Applied Physical Chemistry at Heidelberg University where she stayed until her appointment to Kassel.

Claudia’s research is in nanoscience at the interface between inorganic and physical chemistry, physics and engineering focusing on the production and functionalisation of new materials in the liquid phase. It is widely believed that this field will lead to new materials which, if understood and controlled, will be at the forefront of enabling new, life-transforming technologies. To this end, 2D nanomaterials beyond graphene have received considerable attention. The reason for this is not only their exciting layer number dependent properties, but especially the broad palette of accessible layered crystals potentially giving access to any desired function. However, no matter what material or application, the full potential can only be exploited, when the entire process chain (figure 2) towards a given application is considered.

Claudia’s research is dedicated to optimising processes on the nanoscale and mesoscale for solution processeable nanomaterials, in particular 2D nanosheets and understand fundamental, unifying principles across materials. This includes production of nanosheet dispersions, formulation of inks, size and thickness control of the nanomaterials and their functionalisation on the nanoscale. On the mesoscale, the focus is on deposition and thin film formation with controlled microstructure as well as the fabrication of composites. While the application potential is not specifically investigated by Claudia’s team at the moment, the material production and processing is always optimised to meet the needs of the application scientists in various areas.

In 2008, it was first demonstrated that layered crystals can be delaminated to 2D nanosheets in a process termed liquid phase exfoliation (LPE) resulting in solution processable dispersions ideal to prepare composites from a range of materials exploiting their synergetic properties. This process is at the heart of the research activities in Claudia’s group. Initially, the sample polydispersity was a severe disadvantage, but with continuous progress in size selection, for example through centrifugation, as well as size measurement, the sample quality has seen a tremendous improvement. This is also because size and thickness are manifested in the optical response, which allows to link the spectral profile (e.g. absorption and wavelength-dependent scattering) to the actual nanosheet dimensions quantitatively. Such spectroscopic metrics have now been developed for ~15 materials enabling the production of well-defined samples. This rapid size and thickness quantification is also the foundation for further optimisation of the sample quality and quantity. This process thus provides a constant supply of new 2D nanosheets with unexplored properties and a broad range of surface chemistries in a solution processable form.

Overall, the long-term vision of Claudia's research is to create new "wondermaterials by design" for various application areas from energy storage and conversion to catalysis to electronics to sensing. Undoubtedly, there will not be a single material competitive with the state-of-the-art in so many areas. The approach is to take bulk materials, exfoliate them in liquid in a controlled way (which will give rise to unexplored properties) and then stack them together again differently to create new materials from basic building blocks. To do this rationally, it is required to i) understand the properties of the individual components, ii) exfoliate and deposit them with maximum precision, iii) understand the role of defects and their modification and iv) explore their surface modification to build up hierarchical architectures. Addressing these aspects is in the centre of the current research activities.

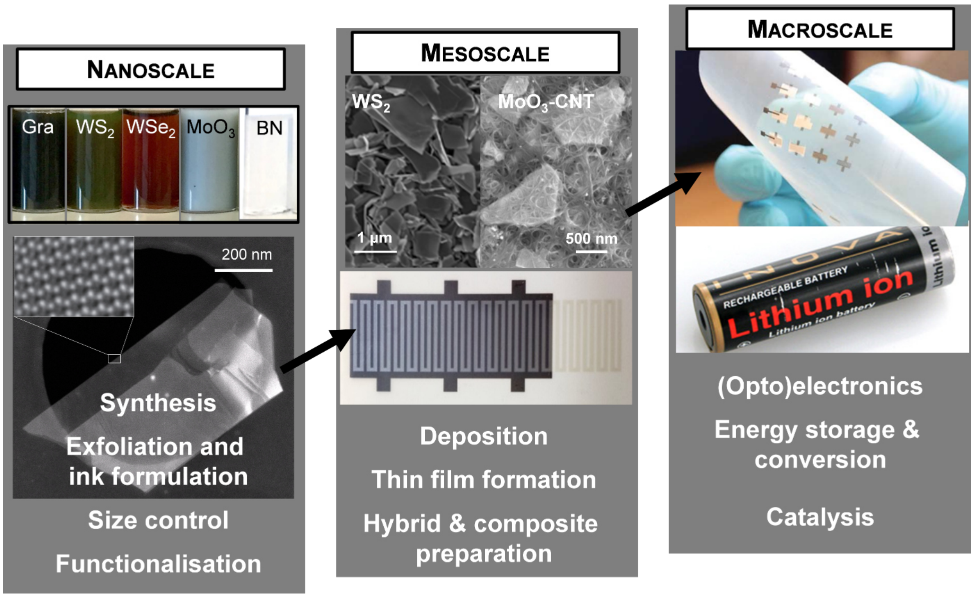

Fig 1: Process chain from production of low dimensional nanostructures in the liquid phase, further processing into thin films and examples of application areas

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Latest Reports
CINSaT autumn colloquium

On Wednesday, 2nd of November 2022, the annual autumn colloquium of the CINSaT took place in lecture hall 282 at the Natural Sciences Campus Heinrich-Plett-Straße of the University of Kassel. This year, the line-up of high-profile speakers attracted numerous professors, doctoral students, and undergraduate students, with nearly 150 people attending at the peak. The autumn colloquium, which is open to all scientific interested persons, offers not only the opportunity to listen to interesting topics on current research from external speakers, but also to have an insight into the current research contents of the CINSaT members and their coworkers during the poster session with 67 posters.

Fig 1: Prof. Dr. Jan Huisken about "Customized, modular, multiscale microscopy inside and outside the optics lab"

The colloquium started traditionally with the welcome speech of Prof. Dr. Johann Peter Reithmaier, head of the CINSaT, who led into the first part of the lecture series that was opened by Prof. Dr. Jan Huisken from the Multiscale Bioimaging Cluster of Excellence (MBExC) at the Georg-August University of Göttingen with his talk about "Customized, modular, multiscale microscopy inside and outside the optics lab", which sparked an interesting discussion and was well received, especially the model to rent out the novel microscopes to external researchers. This interesting talk was followed by a talk titled "Multiple temporal orderings and the philosophy of time" from Prof. Dr. Dr. Norman Sieroka of the University of Bremen. The talk of Prof. Sieroka was organized in collaboration with Dr. Arnold Thordis of the Research Training Group (RTG) Multiscale Clocks and encouraged the audience to challenge their perception of time. After a half-hour coffee break with cookies and cake, which was used not only to get to know each other, but also for the first review of the posters, the second part of the lecture series followed. The third talk of the event was given by Dr. Jürgen Ihlemann with the title "Laser based fabrication of photonic nanostructures and nanoparticles" and afterwards the session was completed with a talk titled "Nanoparticles and plasmonics for sensing application" given by Dr. Georgios Ctistis. Both speakers come from the Institute for Nanophotonics in Göttingen and their talks gave a convincing overview about the challenges of production and application of photonic structures and nanoparticles.

Fig 2: This years CINSaT autumn colloquium attracted a large audience yet again.

Fig 3: Prof. Dr. Dr. Norman Sieroka about "Multiple temporal orderings and the philosophy of time"

Fig 4: Dr. Jürgen Ihlemann about "Laser based fabrication of photonic nanostructures and nanoparticles"

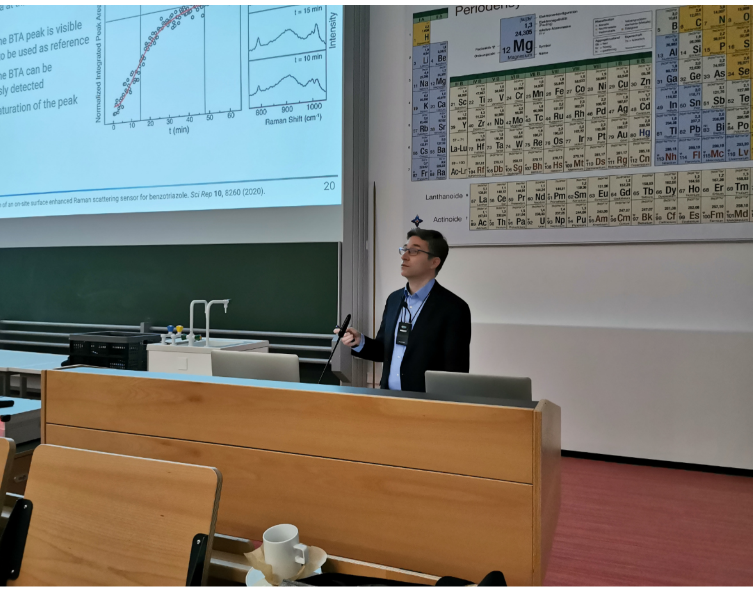


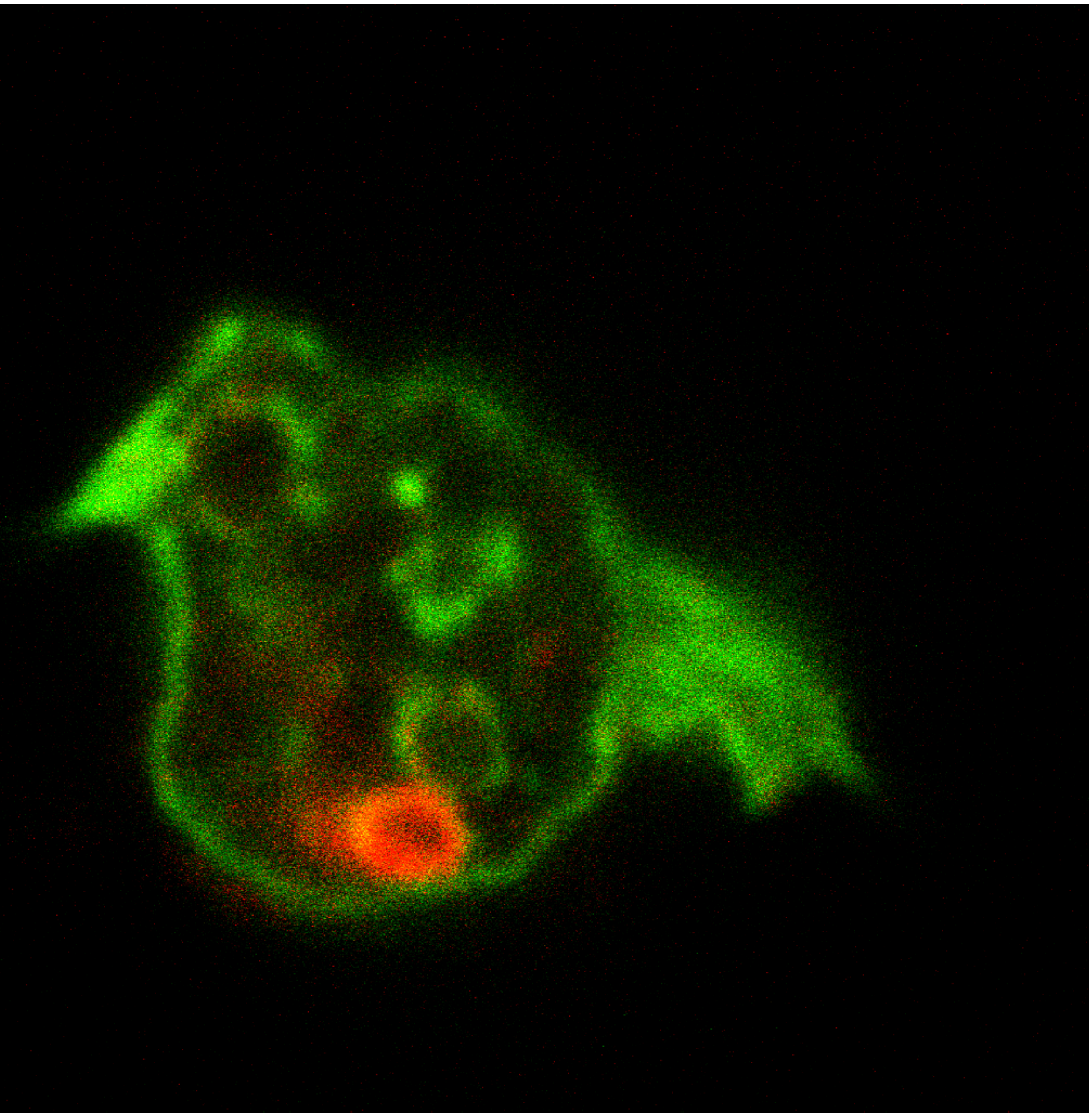
Fig 5: Dr. Georgios Ctistis about "Nanoparticles and plasmonics for sensing application"

The poster session following the lectures showed in total 67 contributions from the groups of the CINSaT members, a new record number. The foyer in front of lecture hall 282 offered not only enough space for the numerous poster contributions, but also for extensive scientific discussions and the exchange of information on current research done within the CINSaT. The catering of the Studierendenwerk Kassel provided again for the well-being of the participants during the event with a wide variety of foods and beverages. The conclusion of the event was the presentation of the poster prizes awarded by this year's jury - consisting of CINSaT members Prof. Dr. Claudia Backes, Prof. Dr. Markus Maniak, Dr. Arne Senftleben and Dr. Daqing Wang - for the three best poster contributions (Gift cards of 200 €, 125 € and 75 € value for the first, second and third place, respectively). The jury emphasized the high scientific quality of the posters in this year’s poster session which made the decision to award the prices very difficult.

The first price was given to the poster titled ""Satiety vs. Starvation" – Neuropeptidomics of the central nervous system of Drosophila melanogaster L3-larvae" by Anna-Sophie Kügler from the Single Cell Analysis within Neuronal Networks young research group (group leader PD Dr. Susanne Neupert). The second and third prize were given to Tim Nowack (Physical Chemistry of Nanomaterials, Prof. Dr. Claudia Backes) with his poster entitled "Aggregation induced emission of N-Heterocycles" and Marina Langhans (Chemical Hybrid Materials, Prof. Dr. Pietschnig) for her poster about “Phospholes as fluorescent dyes for lipid droplets in Dictyostelium discoideum”, respectively. Due to the high number of participants, both in the audience as well as the poster contributions, and the thematically balanced lectures of the speakers, the CINSaT Autumn Colloquium was a success, and we are looking forward to next year.

Fig 6: This year’s poster award winners (from left to right: Tim Nowack, Anna-Sophie Kügler, Marina Langhans).

Nano Arts



Staining of the actin cytoskeleton in green and an endosome in red in a Dictyostelium amoeba cell.

(Prof. Dr. Markus Maniak, cell biology).

Photo: Campus Heinrich-Plett-Straße, Press and Public Relations Office University of Kassel, Studio Blåfield

Imprint

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print:
viaprinto
Martin-Luther-King-Weg 30a
48155 Münster

Responsible according to press law (german: ViSdPR):
CINSaT executive board,
University of Kassel