MAPEX Bremen
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04
03 - 2017

NEWSletter

II HIGHLIGHTS

Ready to use: new generation x-ray Microscope for MAPEX

On 1st December 2016 the time had finally come, the long expected x-ray microscope (XRM), ZEISS Versa 520, arrived and was set-up in the LION building. During the following two weeks, a team of ZEISS and MAPEX scientists and technicians completed the complex installation and calibration procedure. Since January 2017, the instrument is running and standard measurements are possible.

During the initial project phase, we offer to scan test samples of all MAPEX members in order to explore the capabilities and limits of the method with respect to different types of samples. Routine service operations for standard measurements will start in early summer 2017. Different types of in-situ equipment and diffraction contrast tomography will become available within the year.

The instrument is provided by the DFG within a major equipment initiative for XRMs. The corresponding project "In-situ studies of 3D microstructure evolution and spectroscopic imaging during processing and manufacturing of advanced materials." is coordinated by the MAPEX speaker Lucio Colombi Ciacchi, see newsletter 02 (05-2016).

For any questions or queries regarding the XRM, please contact the responsible instrumental scientist, Oliver Focke: **focke@uni-bremen.de**. More details and examples will be presented in the supplementary INSTRUMENT DATABASE in the next newsletter.

Gottfried Wilhelm Leibniz Prize for Lutz Mädler

MAPEX member Lutz Mädler is one of the recipients of Germany's most prestigious research award, the Gottfried Wilhelm Leibniz Prize 2017. Lutz Mädler will receive the prize, which is endowed with 2.5 Mio. €, for his outstanding scientific achievements in the field of mechanical process engineering during the award ceremony on 15th March 2017 in Berlin.

navigare - Career Coaching for Women in Science

‚*navigare*' is a programme for female doctoral and postdoctoral scientists who aim at gaining a leadership position in science. It focuses on central competences for career management in an international context, taking into account gender-specific demands.

The programme will start again in September 2017 as a joint initiative of six running coodinated DFG programmes and MAPEX.

www.uni-bremen.de/mapex > Equal Opportunity

4th MAPEX Early Career Researcher Workshop

The 4th MAPEX Early Career Researcher Workshop will take place on 11th May 2017. The programme will comprise talks from MAPEX Early Career Investigators and short lightning presentations from other participants followed by a poster session. A highlight will be the plenary lecture by Marc Avila, a newly appointed professor at the University of Bremen and director of the ZARM. The day closes with a social evening.

MAPEX Methods Workshop I – Materials Characterization

Scientific equipment and methods often act as a nucleus for cooperative projects. On 13th June 2017 an internal workshop for all MAPEX members will offer a platform for information and exchange on the scientific equipment and expertise available within the MAPEX community. With short presentations and ample time for in-depth discussions, we would like to foster the development of new ideas and initiation of collaborations.

MAPEX funding and support

MAPEX offers funding and/or support for

- research stays abroad,
- new interdisciplinary research projects,
- support for child care during MAPEX events and business trips.

All details and collection dates for proposals are available online:

www.uni-bremen.de/mapex > MAPEX Funding

MAPEX Postcard Collection – Research Highlights

Do you already know our MAPEX postcard collection? We regularly feature research highlights of our members on the MAPEX website and print postcards with pictures/figures from the respective publications. Suggestions for research highlights and postcard motifs are very welcome. Please contact Hanna Lührs.

3RD MAPEX YOUNG SCIENTIST WORKSHOP - SCIENCE MEETS INDUSTRY

Every seat was occupied for the 3rd MAPEX Young Scientist Workshop that took place with more than 60 participants on 27th September 2016. According to the motto "science meets industry" the programme was composed of career talks by representatives from BEGO Implant Systems GmbH & Co. KG, OHB System AG as well as tandem talks on cooperative projects held by a MAPEX member and a cooperation partner from industry (Daimler AG, ficonTec Service GmbH). The generous coffee breaks allowed for a lively exchange between the participants and the presenters from science and industry. A highlight was the plenary talk, which is traditionally given by a newly appointed professor in the MAPEX community: Anne Staubitz took the participants on a fascinating journey through her research "Synthesis as a Tool for Developing New Functional Materials". The talk of MAPEX early career investigator Katharina Koschek from the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM on the "challenges and opportunities of fibre reinforced plastics" was a perfect introduction for the final excursion through the different departments of the IFAM. The day was rounded off by a dinner buffet and get together at the IFAM and later on in the *Haus am Walde*.

More impressions from the Young Scientist Workshop online

www.uni-bremen.de/mapex > impressions

GROUP OF ELDERLY STUDENTS FROM BREMEN AND BIELEFELD VISITING THE LFM

For a delegation of elderly students from Bielefeld the visit of the Laboratory for Precision Machining (*Labor für Mikrozerspanung, LFM*) was one of the highlights during their meeting with the representatives of the elderly students from the University of Bremen. On 27th October 2016, MAPEX Early Career Investigator Lars Schönemann took our guests on an intriguing tour into the world of ultra-precision machining. The visitors were impressed by the insights into the manufacturing of complex optical elements and precision mechanical parts, which often play a key role in diverse technological fields ranging from medical engineering to astronomy. After all questions of the interested audience were answered, Lars Schönemann received a full applause and a small thank-you gift.

MAPEX CALENDAR

28 March 2017 **12:30 Mensa**	MAPEX lunch meeting for Early Career Researchers
25 April 2017 **12:30 Mensa**	MAPEX lunch meeting for Early Career Researchers
11 May 2017	4th MAPEX Early Career Researchers Workshop
30 May 2017 **12:30 Mensa**	MAPEX lunch meeting for Early Career Researchers
13 June 2017	MAPEX Methods Workshop I: Materials Characterization
27 June 2017 **12:30 Mensa**	MAPEX lunch meeting for Early Career Researchers
4 July 2017 **IFAM**	FOR *Schwarz-Silber*, closing colloquium

More events, seminars, and talks related to MAPEX topics:
www.uni-bremen.de/mapex > events > calendar

Universität Bremen

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Link to the online version of the newsletter: *www.uni-bremen.de/mapex > news > newsletter*

Design / Print: Sabrina Goretzki (Print Office University of Bremen)

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MAPEX COMMUNITY
People

Universität Bremen

THE NEWLY ELECTED MAPEX EXECUTIVE BOARD

The MAPEX Executive Board is the central decision making committee of MAPEX and is composed of ten Principal Investigators and two Early Career Investigators. During the general assembly (31st October 2016) the twelve members were (re-)elected. We would like to thank all members of the first MAPEX Executive Board (mandate 2014-2016, see newsletter 02, May 2016) for their engagement and active participation during the foundation phase of MAPEX.

The following eight members were re-elected and have a mandate for two or three (*) years. Their profiles were published in newsletter 02 (May 2016).

- Prof. Dr. Marcus Bäumer
- Prof. Dr. rer. nat. Ralf B. Bergmann*
- Prof. Dr.-Ing. Lucio Colombi Ciacchi*
- Dr.-Ing. Nils Ellendt*
- Prof. Dr. Thorsten M. Gesing
- Prof. Dr. Walter Lang*
- Prof. Dr.-Ing. Lutz Mädler
- Prof. Dr.-Ing. Hans-Werner Zoch

After their re-election Lucio Colombi Ciacchi and Ralf B. Bergmann were confirmed as speaker and vice-speaker of MAPEX during the first meeting of the Executive Board.

Dr.-Ing. Gerrit Dumstorff

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Affiliations

- Faculty of Physics / Electrical Engineering
- Institute for Microsensors, -actuators and -systems (IMSAS)

Research Landscape: System Integration.

Research Focus: Sensing materials: Integrating sensors in different materials, especially metals, by using microsystem and printing technologies; investigations on the effect of sensor integration regarding the macroscopic behavior; characterization of manufacturing processes with material integrated sensors, additive manufacturing processes to build up printed, three dimensional sensors.

Prof. Dr.-Ing. Kurosch Rezwan

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www.ceramics.uni-bremen.de

Affiliations

- Faculty of Production Engineering
- Chair: Advanced Ceramics
- Speaker of DFG Research Training Group 1860 MIMENIMA

Research Landscape: Hybrid materials, Porous Materials, Nanomaterials, Materials synthesis, Materials modelling, Materials engineering.

Research Focus: We investigate, develop, and engineer advanced ceramic materials for applications in the areas of biomaterials engineering, environmental engineering, energy harvesting devices, and aerospace. Our group's current research interests focus on, Novel Processing and Shaping Routes, Bioceramics, Precursor derived Ceramics (Ceramers), Advanced Composites.

Prof. Dr. Anne Staubitz*

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28359 Bremen

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www.uni-bremen.de/staubitz

Affiliations

- Faculty of Biology / Chemistry
- Institute of Organic and Analytical Chemistry
- Organic Functional Materials Group

Research Landscape: Soft and Hybrid Materials, Semiconductors, Materials Characterization, Materials Synthesis.

Research Focus: The group is concerned with the development of synthetic methods for molecular switches that enable to introduce selective responsiveness to stimuli into polymers and composites and small molecules. Such stimuli can be light, mechanical force or heat. The second thrust of research deals with the incorporation of unusual main group elements into organic semiconductors and the preparation of inorganic analogs of organic polymers. This research necessitates the development of new synthetic methodology and often leads to the discovery of unknown reactivity patterns of functional groups.

Prof. Dr. Tim Wehling

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Affiliations

- Faculty of Physics / Electrical Engineering
- Institute for Theoretical Physics
- Chair: Electronic structure and correlated nanosystems
- Bremen Center for Computational Materials Science
- Co-Speaker of Research Training Group 2247: QM³

Research Landscape: Materials Modeling, Nanomaterials, Semiconductors, Metals.

Research Focus: Theory and modelling of nanostructured materials and electronic correlation effects. Research topics include interface, inhomogeneity and adsorbate effects in low dimensional materials, magnetic nanostructures, surfaces and strongly correlated electron systems, where we study structural, electronic, optical and magnetic properties. Our research includes the development of quantum many-body techniques and their application in contexts like 2d materials, metals or semiconductors.

SCIENCE & PROJECTS
Running coordinated DFG projects

Universität Bremen

II RESEARCH TRAINING GROUP 1860: MICRO-, MESO- AND MACROPOROUS NONMETALLIC MATERIALS: FUNDAMENTALS AND APPLICATIONS (MIMENIMA)

The 2nd generation of MIMENIMA PhD students and Postdocs started in October 2016

16 young researchers with different cultural and scientific backgrounds such as engineering, biology, chemistry, and material sciences started their projects on tailored novel porous ceramic structures for applications in energy supply, environmental and chemical processing, as well as space technology in October 2016. Therefore, the DFG-funded research training group Micro-, meso- and macroporous nonmetallic Materials: Fundamentals and Applications (MIMENIMA) celebrated a kick-off meeting, which was a farewell meeting for the 1st Generation as well, on October 17th. Students and

Research Training Group 1860: Micro-, meso- and macroporous nonmetallic Materials: Fundamentals and Applications (MIMENIMA)

Funding: 2013 – 2018 (1st funding period)

Speaker: Kurosch Rezwan

Subproject leaders from MAPEX: Marcus Bäumer, Udo Fritsching, Thomas Hochrainer, Stephen Kroll, Lutz Mädler, Kurosch Rezwan, Jörg Thöming.

Website: www.mimenima.uni-bremen.de

postdocs will work together on this challenging topic within an interdisciplinary team of 13 project leaders from three faculties at the University of Bremen (Production Engineering, Biology/Chemistry, Physics/Electrical Engineering) and from the University of Dresden. In addition to this multidisciplinary research programme, MIMENIMA offers an educational programme with tailored scientific lectures, seminars, lab courses, workshops, summer schools, research visits at international cooperation partners, and a mentoring programme for the career development of women (navigare) and an ongoing coaching of the scientific work.

II PRIORITY PROGRAMME 1676: DRY METAL FORMING - SUSTAINABLE PRODUCTION THROUGH DRY PROCESSING IN METAL FORMING

Metal forming is one of the most energy-efficient production technologies, due to the high degree of material utilisation. Currently, lubricants are applied in all groups of metal forming processes to reduce friction between work piece and forming tool, to reduce tool load, and to protect workpieces against corrosion. From economical and ecological points of view, there is a strong demand to avoid lubricants in metal forming processes, which are mostly mineral oil based and bear a significant environmental impact. Dry metal forming is a process where a work piece leaves the forming tool without the necessity of cleaning or drying before subsequent production steps such as coating or joining processes. The absence of a lubricant as an interlayer between work piece and forming tool, however, results in an intense mechanical interaction between work piece surface and forming tool surface. The central contribution of the priority programme is the development of new dry forming processes and the adaption of relevant technologies to contribute to the goal of a lubricant-free press plant. This can e.g. be achieved by a targeted surface modification or by reducing stresses by process technical measures. The priority programme has currently 11 ongoing projects with a total of 25 participating research institutions from all over Germany.

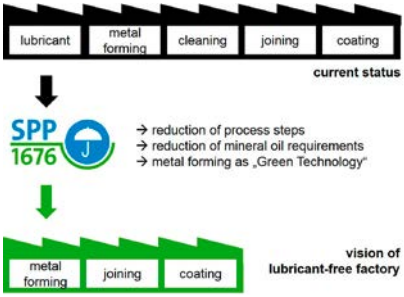
Priority Programme 1676: Dry Metal Forming - Sustainable Production through Dry Processing in Metal Forming

Funding: 2013 – 2019

Speaker: Frank Vollertsen

Subproject leaders from MAPEX: Bernd Kuhfuß, Frank Vollertsen, Hans-Werner Zoch.

Website: www.trockenumformen.de



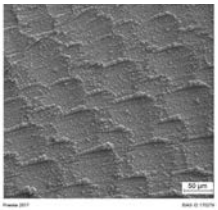


Fig. 1: Vision of the priority programme

Fig. 2: Silicon-based accommodation layer on micro-structured steel substate deposited as prerequisite to enable diamond growth on tool steel.

RESEARCH UNIT 1224: *SCHWARZ-SILBER* ALUMINIUM-CARBON FIBRE REINFORCED PLASTICS (CFRP) TRANSITION JOINTS IN LIGHTWEIGHT CONSTRUCTIONS

Especially for fuel reduction and energy saving, lightweight constructions are very important. Therefore, it is a current topic in the construction of automobiles or airplanes. Because of the high requirements which both industries have to comply with, different materials with different specific properties have been used. The right joining technique is the key for using the whole potential of different materials. For several years, the DFG Research Unit ‚*Schwarz-Silber*' has been investigating joints between aluminium and CFRP with a transition structure. Both materials have a low density, thus they are suitable for hybrid lightweight constructions. In hybrid constructions, conventional joining techniques like bolting, riveting or bonding introduce a weak spot between both materials. In the research unit, several alternative concepts have been developed for joining these two materials. Two of these concepts are the foil concept and the fiber concept. In the foil concept, the open end of titanium sheets, which are integrated in a hybrid laminate with CFRP, will be welded with aluminium. In the fibre concept, glass fibre wovens will be partially cast in aluminium and afterwards carbon fibre wovens will be integrated on the glass fibre wovens via an infusion process. The benefits are light and especially slim joints with no overlaps. Furthermore, these joints have better corrosion properties in comparison to a direct joint of aluminium and CFRP.

On 4th July 2017, overall results of the research unit will be displayed at a closing colloquium which will take place at the Fraunhofer IFAM in Bremen. Interested parties are welcome to attend.

Research Unit 1224: *Schwarz-Silber* Aluminium-Carbon Fibre Reinforced Plastics (CFRP) transition joints in lightweight constructions

Funding: 2010 - 2017

Speaker: Axel S. Herrmann

Subproject leaders from MAPEX: Frank Vollertsen, Matthias Busse, Hans-Werner Zoch.

Website: www.for-schwarzsilber.de

Developments of the Reseach Unit Schwarz-Silber:

Left: Fiber Concept - Right: Foil concept

II RESEARCH UNIT 1845:
ULTRA-PRECISION HIGH PERFORMANCE CUTTING

Ultra-precision milling is an essential process for generating complex optical parts and molds. Due to the required precision, it is typically conducted as a fly-cutting procedure (i.e. only a single cutting edge) at low spindle speed and low feed rate. The consequences are extremely long manufacturing times that can take up to several hours or even days.

The DFG Research Unit ‚Ultra-Precision High Performance Cutting' (UP-HPC) aims to reduce these manufacturing times via scientific means, in order to leverage the economic applicability of this technology in the precision manufacturing industry. This is done in five interdisciplinary subprojects at the Universities of Bremen and Hannover. Collaborating research institutes in Bremen are the LFM (Prof. Brinksmeier) and the bime (Prof. Kuhfuß) and in Hannover the IFW (Prof. Denkena).

The long primary processing times are covered by the Research Unit in three projects, dealing with the development of adjustable tool holders that allow for multi cutting edges to be applied, the exploration of high cutting speed in diamond machining as well as the development of a highly dynamic feed axis on the basis of electromagnetic actuators. For speeding up auxiliary processing times, e.g. tool alignment, (semi)automated balancing procedures are being developed in a fourth project, while the fifth project covers the improvement of process stability at high speeds by using model-based approaches for the machine's control system.

Research Unit 1845:
Ultra-Precision High Performance Cutting

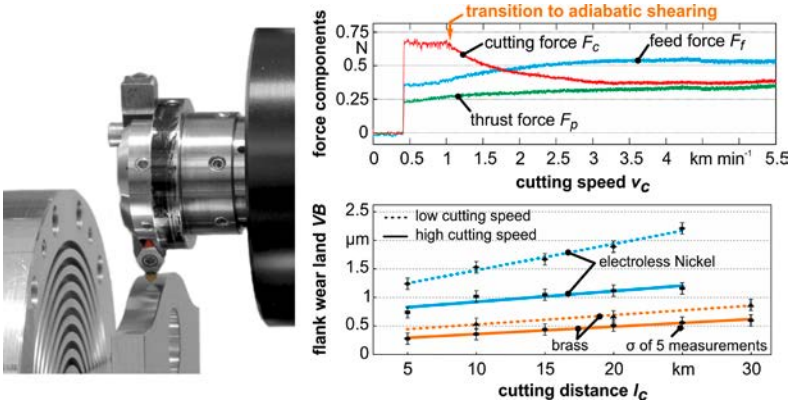
Funding: 2014 - 2020

Speaker: Ekkard Brinksmeier

Administration: Lars Schönemann

Subproject Leaders from MAPEX:
Ekkard Brinksmeier, Bernd Kuhfuß

Website: www.up-hpc.de



Left: ultra-precision fly-cutting of a freeform optic; Right: development of cutting forces and tool wear at high cutting speeds.

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03-2017

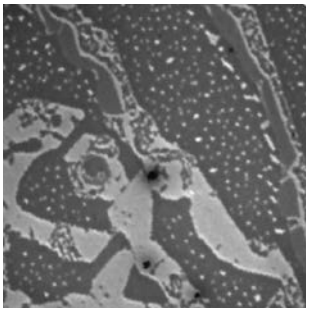
INSTRUMENT DATABASE
In situ structural and chemical imaging of surface processes

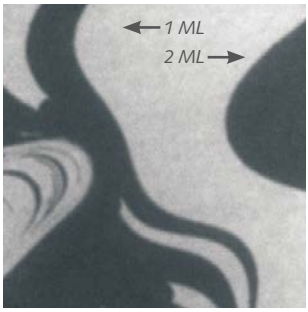
Universität Bremen

LEEM - LOW ENERGY ELECTRON MICROSCOPY

Adsorption, materials deposition, etching, and corrosion are processes that invariably result in a distinct modification of the structural, electronic, and chemical properties of materials. Low-energy electron microscopy (LEEM) is a surface-sensitive full-field diffractive imaging technique that provides real-time access to the mesoscale surface morphology with nanometer resolution and local atomic structure. Operating in a wide range of conditions from ultra-high vacuum (10^{-10} mbar) to gas ambients (10^{-4} mbar) and temperatures from liquid nitrogen to above the melting point of the coinage metals, LEEM is ideally suited to follow sample modification in heteroepitaxial growth, thermal annealing, oxidation, and chemical reactions at video rates.

The left image shows a silicon carbide (0001) surface partially covered by free-standing single-layer (bright) and bilayer (dark) graphene sheets, which can unambiguously be identified with pixel resolution owing to their energy-dependent electron reflectivity. The same physical effect, generally known as quantum size contrast, serves to elucidate the growth mechanism and local thickness of epitaxial silver films on a Ni(111) single crystal (right image).





left image: single (bright) and bilayer (dark) graphene flakes on a SiC(0001) substrate (field of view: 3 µm).

right image: crystalline single (bright, 1 monoatomic layer (ML)) and bilayer (dark, 2 ML) silver films on Ni(111) grown in situ by molecular beam epitaxy (field of view: 9 µm).

|| LEEM - LOW ENERGY ELECTRON MICROSCOPY

Low-energy electron microscope

01 || General Information

Keywords: surface microscopy, surface diffraction, surface dynamics.

Categories:

- Diffraction,
- Electron Microscopy,
- Surface / Interface Characterization.

Main Application: in-situ structural characterization of near-surface transformation processes in real-time.

Measured Quantities: surface morphology, surface structure.

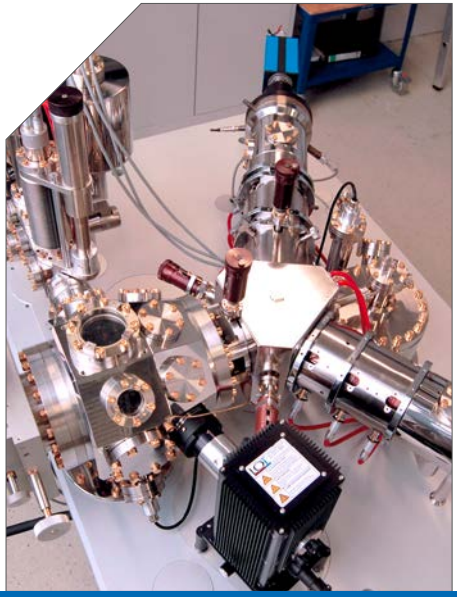
Features: in-situ sample preparation by molecular beam epitaxy.

Year of Fabrication: 2010.

Manufacturer: Elmitec.

02 || Specifications

Low-energy electron microscopy is a full-field diffractive imaging technique that allows imaging the morphology and surface structure of a crystalline sample at a lateral resolution down to about 10 nm for fields of view in the range of 3 to 50 microns at video rates (~10 Hz). Vertical resolution is limited to imaging of atomic surface steps. Preferred sample characteristics: flat, mono- or polycrystalline specimens up to 9x9 mm^2, thickness up to 2 mm; temperature range during operation: 300 - 1300 K; gas dosing from ultra-high vacuum up to 10^{-4} mbar during operation.



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