MAPEX Bremen
Material. Process. Excellence.

05
12-2017

NEWSletter

II HIGHLIGHTS

ERC Consolidator Grant for Fabio La Mantia

MAPEX member Fabio La Mantia is one of the 329 out of 2.538 scientists awarded with a Consolidator Grant by the ERC for his project: *"EllonT - Electron- and Ion Transfer at the Interface: a Hyphenated Dynamic Multi-Frequency Approach"*. With these grants the ERC funds promising scientists in consolidating their independent research with up to 2 million Euro. In 2015 Fabio La Mantia became professor for Energy Storage and Energy Conversion Systems at the Faculty of Production Engineering in cooperation with the Fraunhofer IFAM.

Second funding phase for transregional Collaborative Research Centre CRC TR 136

PROZESS SIGNATUREN
TRANSREGIONALER SONDERFORSCHUNGSBEREICH 136

"Function-oriented manufacturing based on characteristic process signatures". From 2018 to 2021, the group of researchers around Ekkard Brinksmeier (University of Bremen) and Fritz Klocke (RWTH Aachen) will continue their work together with colleagues from the Oklahoma State University. In their fall meeting the DFG grants committee has allocated 9.5 million Euro for the second funding phase of the CRC 136.

IWT new member of the Leibniz-Association

From 1st January 2018 the *Stiftung Institut für Werkstofftechik IWT* becomes a new member of the Leibniz-Association. With its new name *Leibniz-Institut für Werkstofforientierte Technologien*, the IWT is the third Leibniz institution in Bremen and will be jointly funded by the Federation and the federal states because of its international importance.

Excellence Strategy

It has been a long and intensive process, which ultimately gave rise to the draft proposal for a Cluster of Excellence "Metals on Demand (MODE) – An ontological approach to metals engineering and manufacturing" – unfortunately without a happy end. Out of the five draft proposals, submitted by the University of Bremen, only one (marum) was allowed to proceed to the full-proposal stage, together with 87 other initiatives from 41 universities throughout Germany.

What remains after two years of intense discussions, countless meetings with different groups on all levels – from the enthusiastic early career investigators up to the rectorate and senatorial authority?

We still have the vision of a novel predictive engineering approach and will follow the idea to establish 'materials informatics' as a new field of research at the University of Bremen. The creative discussions gave rise to many great ideas for innovative projects and have already initiated several new collaborations within the MAPEX community. We are grateful for the huge support we experienced, for all those great ideas as well as for the motivation, commitment, and confidence of all parties concerned. The initiative has gained a lot of momentum within MAPEX, promising a boost for the whole community, especially in terms of new infrastructure and support for early career researchers. Despite the deep disappointment about the rejection of the draft proposal, there are ongoing discussions about alternative funding possibilities in order to revive this enthusiasm, pursue at least some of the ideas of MODE, and strengthen the whole MAPEX community by investing in new state-of-the-art equipment, new professorships, and the support of early career researchers.

Helmholtz-Zentrum Geesthacht (HZG)

In June, a delegation of MAPEX members visited the Centre for Materials and Costal Research. During their visit, the HZG scientists introduced them to their most recent research topics: materials for hydrogen technology, corrosion protection coatings, laser shock peening, tailored polymers for membrane-based separation, experimental mechanics of lightweight materials, and biocompatibility of biomedical implants. Finally, the scientists from Geesthacht and Bremen discussed possible synergies and starting points for new cooperation. "There are a lot of direct connections between the research in Bremen and at the HZG" stated Wolfgang Kaysser, scientific director of the HZG.

Centre for Advanced Materials (ZHM)

A delegation of scientists from the Centre for Advanced Materials around their director Norbert Huber visited MAPEX in September. They were introduced to ten different MAPEX areas including the four non-university research institutes. The guests were impressed by the collaborative spirit within MAPEX as well as by the passion and motivation of the individual scientists presenting their research. The ZHM sustains the collaboration within the collaborative research centre 986 between the Hamburg University of Technology (TUHH) and the HZG in the field of materials science in an institutional setting.

II METHODS WORKSHOP I – MATERIALS CHARACTERIZATION

Scientific equipment and methods often act as a nucleus for cooperative projects.

Jan Ingo Flege, University of Bremen.

The first MAPEX Methods Workshop on Materials Characterization took place in the TAB building on 13 June 2017. More than 30 participants from chemistry, materials science, physics, and production engineering enjoyed 10 accessible, yet in-depth presentations covering the full range from high-precision measuring techniques to exciting in situ experimental approaches to quantify the structural, physical, chemical, and optical properties of materials and elucidate their synthesis, transformation, and modification by various treatments. PhD students, postdocs, and MAPEX PIs alike were excited to learn about existing state-of-the-art instruments and technical expertise that are available for collaborative use within the MAPEX community. The presented material is also available for download in the universities internal network.

II 4TH MAPEX EARLY CAREER RESEARCHER WORKSHOP

Building bridges across the borders defined by the faculties and institutes

During the 4th Early Career Researcher Workshop (formerly named Young Scientist Workshop) on 11 May 2017, 50 young scientist met in the TAB building to present and discuss their work and contribution to MAPEX. Beside three keynote presentations from Gerrit Dumstorff (FB1, IMSAS), Nils Ellendt (IWT, SFB1232) and Andrea Kirsch (FB2, CKfS) 20 master students, PhD candidates, and postdocs introduced their work in lightning presentations followed up by poster sessions. "It is interesting and exciting to see, what people are dealing with in their daily scientific work and how they actually define scientific work", said one of the participants. Another participant praised the relaxed atmosphere, where master students, PhD candidates and postdocs get together. A highlight of the workshop was the plenary talk "Processes at fluid interfaces" by Mark Avila. The new Head of the ZARM gave an exciting insight into the scientific work of his group. The workshop finally ended in the city centre with a slightly different presentation: A night watchman lead the participants through the old city of Bremen, telling stories about the city by walking from the marketplace over the Schlachte to the Schnoor Viertel.

II MAPEX SYMPOSIUM 2017 – MATERIALS INFORMATICS

An emerging research field at the University of Bremen

Krishna Rajan (University at Buffalo, USA)

On 15 September 2017 MAPEX had the honour to host three internationally leading scientists from the still young research field ‚materials informatics' in the Haus der Wissenschaft, attracting more than 50 scientist from the University of Bremen.

For a growing number of research projects within the MAPEX community aspects of 'materials informatics' are gaining importance and will be of great relevance in the future. The symposium was an essential step towards the establishment of 'materials informatics' as a new research field at the University of Bremen. Thanks to the invited guests, the idea of materials informatics is now firmly embedded in our scientist's minds. The symposium comprised invited talks by:

Nicola Marzari (National Centre for Competence in Research, EPFL Lausanne, Switzerland) *"Computational design and discovery of novel materials";*

Krishna Rajan (Department of Materials Design and Innovation, University at Buffalo, USA) *„Discovering the science of materials through Informatics";*

Ankit Agrawal (Department of Electrical Engineering and Computer Science, Northwestern University, USA) *„Materials informatics and big data: realization of ‚fourth paradigm' of science in materials science".*

The programme was completed by three keynote talks from the University of Bremen:

„The urgent need for metals engineering ontologies", **Lucio Colombi Ciacchi,** MAPEX speaker;

„Ontology Engineering and Ontological Data Access", **Carsten Lutz;**

„High-throughput with particle technology", **Lutz Mädler.**

Ten flashlight and poster presentations by early career researchers from the MAPEX community rounded off the programme and lead to lively discussions during the poster sessions.

Daniel Otero Baguer (University of Bremen) and Sybrand van der Zwaag (member of the MAPEX International Advisory Board, TU Delft, Netherlands).

II 5TH MAPEX EARLY CAREER RESEARCHER WORKSHOP

Science meets industry – spin-offs and cooperation projects

5 MAPEX Early Career Researcher Workshop

About 40 participants from the University of Bremen and Hochschule Bremen were highly impressed by the contributions presented at the 5th MAPEX Early Career Researcher Workshop on 16 November 2017. According to the motto "spin-offs and cooperation projects" Meike Goos (picture) from the Knowledge and Technology Transfer Unit of the University of Bremen introduced possibilities for scientists to set up a business originating from Bremen's universities. In vivid contributions, three spin-offs of the University of Bremen shared their experience packed full with anecdotes and practical recommendations how to bring your ingenious idea into a ready-to-sell product. The key message to take home from all three founders, Cord Winkelmann (sensosurf), Stefan Frehse (SCiLS), and John Schlasche (Additive Works), is "Talk to your customer!"

In the afternoon, the audience was taken onto an intriguing trip on how academic research and industrial development can work hand in hand. In two tandem talks, Arne Kunze from the Stiftung Institut für Werkstofftechnik (IWT) and Sabine Wagner (Form Tech GmbH) as well as Michael Brink from the Institute for Integrated Product Development (BIK) and Lars Ischtschuk (SAERTEX GmbH & Co. KG) presented successful examples for the workshop motto "science meets industry".

Meike Goos, University of Bremen.

A lively exchange between the presenters and the participants took place during the lunch break and coffee breaks. As a final highlight, the MAPEX speaker Lucio Colombi Ciacchi (Hybrid Materials Interfaces) closed the imposing day with a presentation of his own research, showing that the understanding of processes on the atomistic scale can push forward industrial development.

Navigare Career Coaching for Women in Science

Due to the great demand, two parallel coaching programmes for 27 female early career researchers started as a joint initiative of six running coordinated DFG programmes and MAPEX. The coaches Monika Clausen and Christine Issa will guide their groups through the one-year programme. The participants will gain central competences with respect to their own career management, with a special focus on gender-specific demands within the science system. 'Classical' programme is offered in German with a slightly stronger focus on possible gender barriers in science whereas, the 'international' version is in English and with a stronger emphasis on the scientific career of female scientists in an international environment.

MAPEX CALENDAR

30 January 2018 12:30	MAPEX Lunch Meeting for Early Career Researchers
25 January 2017	ECI meeting and neighbour visit, Fraunhofer IFAM
27 February 2018 12:30	MAPEX Lunch Meeting for Early Career Researchers
27 March 2018 12:30	MAPEX Lunch Meeting for Early Career Researchers
25 April 2018	6th MAPEX Early Career Researcher Workshop – building bridges
May 2018	MAPEX Methods Workshop II – Computational Materials Science
18 – 19 June 2018	MAPEX Symposium 2018
25 October 2018	7th MAPEX Early Career Researcher Workshop – science meets industry

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

Universität Bremen

MAPEX Bremen
Material. Process. Excellence.

www.uni-bremen.de/mapex

IMPRINT/CONTACT DETAILS

MAPEX Center for Materials and Processes, University of Bremen,
Bibliothekstraße 1, 28359 Bremen

Editorial team:
Susan Köppen (BCCMS, FB4), Hanna Lührs (MAPEX), Michael Maas (FB4)

Further information and subscription to the pdf newsletter: mapex@uni-bremen.de
Link to the online version of the newsletter: *www.uni-bremen.de/mapex > news > newsletter*

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

MAPEX Bremen
Material. Process. Excellence.

06
12-2017

MAPEX COMMUNITY
Institutes

Universität Bremen

|| BIAS – BREMER INSTITUT FÜR ANGEWANDTE STRAHLTECHNIK

Knowledge creates business is the guiding principle of BIAS – Institute of Applied Beam Technology. The transfer from basic research into industrial applications has been the focus of the institute's work for many years. Applications of young, creative scientists are always welcome.

In July 2017 the first non-university, civilian laser institute in Germany celebrated its 40th anniversary. Being a pioneer is always both a challenge and a chance. The challenge does not end by sucessfully establishing an institute. Tasks and options are ever changing not only due to technological changes, but also due to changes in the market. Having a team of excellent researchers, who can use the latest developments in laser sources was one of the key factors of our success, says Prof. Vollertsen, Managing Director. In recent years, there are many positive developments to report: New welding methods developed at BIAS are successfully used in the aircraft and automotive industry, and numerous developments are made for space research, shipbuilding, railway vehicle manufacturing, semi-conductors, opto-electronics, and electron-optics.

BIAS – Bremer Institut für angewandte Strahltechnik GmbH
(Institute of Applied Beam Technology)

Klagenfurter Str. 5 || 28359 Bremen
Germany || +49 421 218 58000
info@bias.de || www.bias.de

Facts and Figures
- founded 1977
- about 100 employees

Managing Directors

Prof. Dr.- Ing. Frank Vollertsen
Material Processing and Processing Systems,

Prof. Dr. rer. nat. habil. Ralf B. Bergmann
Optical Metrology and Opto-Electronic Systems

Erika Taulien-Matthies
Finance and Administration

|| FIBRE – FASERINSTITUT BREMEN E.V.

Faserinstitut Bremen e.V. (FIBRE) was founded in 1969 as a laboratory and is a successful research institute on the campus of the University of Bremen today. Since 2001 the head of the institute is Prof. Dr.-Ing. Axel Herrmann. The interdisciplinary team of about 50 scientists, engineers and technicians works on the development of high-performance fibre composites, technical textiles, and fibre reinforced plastics as well as manufacturing technologies, quality assurance, material development, and characterisation. Although FIBRE is legally independent, it is closely linked to the university including a strong engagement in teaching.

The institute operates a number of pilot plants and a laboratory which is accredited according to ISO 17025. Research focal points are materials modelling and simulation, design of lightweight solutions using composite materials and new production technologies. Additionally, the institute investigates and produces functionalized fibres and develops new test methods for fibres and composites. Due to the interdisciplinary nature of its topic „fibre based composites“, Faserinstitut is well connected with institutes and industry partners and active in several competence-networks.

FIBRE Technikum

Faserinstitut Bremen e.V.
Am Biologischen Garten 2
28359 Bremen || Germany
www.faserinstitut.de

Facts and Figures
- founded 1969
- about 50 employees

Managing Director

Prof. Dr.- Ing. Axel S. Hermann
☎ +49 421 218 58700
✉ sekretariat@faserinstitut.de

MAPEX Bremen
Material. Process. Excellence.

05
12-2017

SCIENCE & PROJECTS
Projects funded by MAPEX

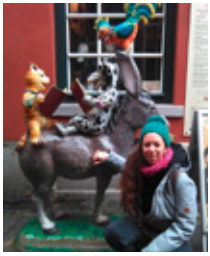
Universität Bremen

MAPEX PHD RESEARCH GRANTS

MAPEX promotes the international exchange of PhD researchers, who can apply for short-term research grants for a research stay either at the University of Bremen in the group of a MAPEX member (incoming) or at a research institution abroad (outgoing).

Since the introduction of this funding line in late 2015, 12 PhD researchers (6 incoming, 6 outgoing) seized the opportunity to gain international research experience and establish their own international networks. Short reports of three selected grantees are printed here, for a complete list of funded projects please refer to the MAPEX website.

PHYSICAL CHARACTERIZATION OF NEW POLYBENZOXAZINES AND EFFECT OF PHENOLS AS CATALYSTS



Alba Martos Carmí (Universitat Autònoma de Barcelona, Spain) visiting Dr. K. Koschek (IFAM)

February 2017: The main objective during my visit was to generate knowledge of a great variety of techniques in the field of polymers, such as, swelling, gel content, dynamic mechanical analysis (DMA) and thermogravimetric analysis (TGA). Those techniques were applied for the characterization of new polybenzoxazines, making it possible to extend the studies of my doctoral thesis in the Autonomous University of Barcelona (UAB).

Finally, I especially want to thank Dr. Koschek and Dr. Soto for dedication and help by giving me new future ideas based on the results obtained. The experience was very positive and useful.

II STRUCTURAL AND MAGNETIC PROPERTIES OF NANOCRYSTALLINE SEMICONDUCTORS

Andrea Kirsch (FB2, Solid State Chemical Crystallography) at the HERCULES school 'Neutrons & Synchrotron Radiation for Science' in Grenoble (France)

March 2017: I got the chance to attend the international Hercules school, which is a 5-week course and one of the most regarded schools worldwide for users of synchrotron or neutron radiation sources. It has been held in Grenoble, France at the Institute Laue Langevin (ILL) and the European Synchrotron Radiation Facility (ESRF) and included lectures, practical courses, tutorials, the visit of large facilities, and a poster session. The lectures cover fundamentals in physics and chemistry, basic methods and instruments using synchrotron and neutron radiation as well as specialized topics in the application to physics, biology, engineering, and chemistry of condensed matter.

I gratefully thank the University of Bremen and the MAPEX Center for Materials and Processes for giving me the opportunity to make this outstanding experience that clearly added a great value to my PhD as well as to my personal development.

II COMPUTATIONAL STUDY OF THE VIBRATIONAL PROPERTIES OF ZEOLITIC IMIDAZOLATE FRAMEWORKS WITH SUBSTITUTED LINKERS

Filip Formalik (Wrocław University of Science and Technology, Poland) visiting Dr. Michael Fischer (FB5, Crystallography)

September – October 2017: The research topics raised during my internship in the Crystallography Group at the University of Bremen were closely related to the subject of the work carried out within my PhD studies at Wroclaw University of Science and Technology. The subject of collaboration was a computational study of the vibrational properties (phonons) in zeolitic imidazolate frameworks.

Thanks to the opportunity to pursue an internship at the University of Bremen, funded by MAPEX, and the invaluable help of Dr. Michael Fischer I learned a new technique of calculation of vibrational properties of porous crystals, which will be very useful for my future work, within and beyond my PhD studies. Besides my development in the field of methodology we also made a considerable progress in solving very interesting scientific problems.

All information on the funding opportunities for Early Career Researchers is available on the MAPEX website.

MAPEX Bremen
Material. Process. Excellence.

05
12-2017

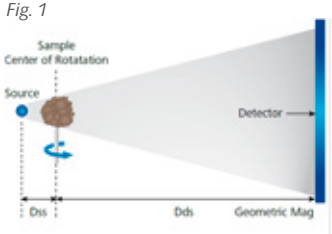
INSTRUMENT DATABASE
Non-destructive 3D imaging and testing of materials

Universität Bremen

X-RAY COMPUTED TOMOGRAPHY (X-CT)

3 D X-ray micro-computed tomography (micro-CT) provides non-destructive access to the internal microstructure and composition of materials.

Fig. 1



The sample, situated between x-ray source and detector, sequentially rotates in steps of less than 1°. During a full 360° rotation several hundred projection images are taken. After numerical back projection of the images, the volumetric data can be visualized and analysed using software tools such as Volume Graphics that provide access to any desired 3D view or 2D cross section of the sample. The magnification using conventional CTs depends on the source-sample-detector distance (Fig. 1).

Using X-CT it is possible to non-destructively:

- investigate microstructural properties at multiple length scales;
- characterize and quantify pore structures and inclusions;
- investigate grain and fibre orientation;
- characterize and observe fracture mechanics;
- visualize biologic structures including cellular and subcellular features;
- investigate historic artefacts.

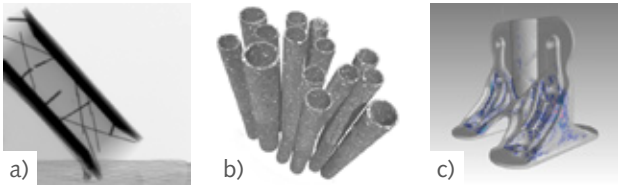


Fig. 2: a) X-ray image of a compression- and impact-loaded pin-reinforced sandwich structure; b) 3D view of bi-component fibers (Ø 200 µm); c) short fibre injection moulded T-bracket, 3D view and color-coded pore analysis.

|| X-RAY CT: PHOENIX-XRAY V|TOME|X M

01 || General Information

Keywords: X-ray computed tomography, tomography, non-destructive testing, in situ, X-CT, CT, NDT

Categories: Material Properties, Dimensional Properties, Surface / Interface Characterization

Main Application: 3D material characterisation, in situ experiments and non-destructive testing of metals, compound materials, and opto-electronic components

Measured Quantities: 3D-shape, defects, interfaces, volume

Year of Fabrication: 2014, funded by Wirtschaftsförderung Bremen WFB

Manufacturer: General electric (GE); Phoenix-xray vltomelx m; research edition

Features: special in situ equipment for time dependent 4D studies during heating, cooling, under tension or tensile compression.

02 || Specifications

- 180 kV / 15 W nano-focus x-ray tub
  Detail Detectability: down to 1 µm (object size 2 mm)
- 240 kV / 320 W micro-focus x-ray tube (up to 40 mm steel)
  Detail Detectability: down to 3 µm
- Max. Object Size (height x diameter) 600 mm x 500 mm;
- Max. Object Weight 50 kg

03 || Contact:

Oliver Focke
Faculty 4 – Production Engineering
☎ +49 421 218 64582
✉ focke@uni-bremen.de

Christian Kapitza
BIAS
☎ +49 421 218 58034
✉ kapitza@bias.de

Location: LION

Principal Investigators:
Ralf B. Bergmann, Axel Herrmann

MAPEX Bremen
Material. Process. Excellence.

06
12-2017

INSTRUMENT DATABASE
Non-destructive 3D imaging and testing of materials

Universität Bremen

X-RAY MICROSCOPY (XRM)

3 D X-ray microscopy provides non-destructive access to the internal microstructure and composition of materials. In contrast to conventional X-CT (only geometric magnification), the X-ray microscope Versa 520 offers a two-stage magnification. The additional optical magnification (Fig. 1) enables high resolution at large source-sample distances and therefore provides a large flexible working distance while maintaining submicron resolution (Fig. 2). This allows high-resolution for large samples as well as for in-situ experiments. The latter can be performed with the 5kN in situ tensile stage (Deben CT5000), operating from -20°C to 160°C.

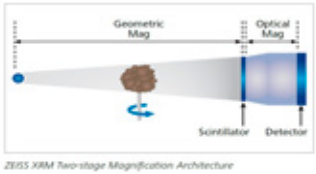


Fig. 1: Two-stage magnification architecture (Zeiss).

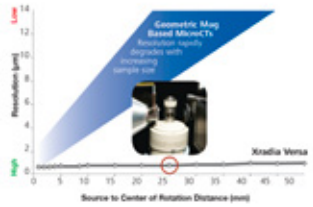


Fig. 2: Resolution as a function of source to sample distance (Zeiss).

Additional unique features of the XRM are laboratory **diffraction contrast tomography (DCT)** for the mapping of grain orientations in polycrystalline materials even without grain contrast and **propagation phase contrast** for the visualization of low absorbing or low contrast materials such as: low atomic number (low Z) materials, soft tissue, polymers, fossilized organisms encased in amber, and other materials of low contrast. This enables e. g. the separation of carbon fibres from its polymer matrix and consequently the analyses of fibre orientation (Fig. 3).

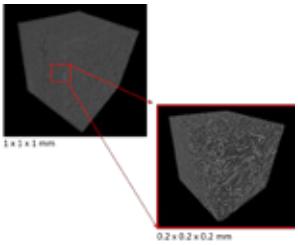


Fig. 3: Section of a short fibre (length 200 µm, diameter 7 µm) injection moulded part. The unique combination of high resolution and phase contrast enables the 3D determination of single fibre orientation

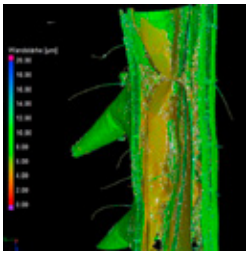


Fig. 4: Wall thickness analyses of a grasshopper leg.

II X-RAY MICROSCOPE ZEISS XRADIA VERSA 520

01 II General Information

Keywords: X-ray, non-destructive testing, tomography, CT, XRM, X-CT, NDT

Categories: Microscopy, Material Properties, Dimensional Properties

Main Application: non-destructive testing, material characterization, 3D microstructure, in situ experiments

Measured Quantities: 3D-shape, pores, defects, interfaces

Features:

- spatial resolution <700 nm
- Flat panel and CCD (2K x 2K) detector high contrast
- 5 kN tensile & compression testing system, operating between -20°C and 160°C

Year of Fabrication: 2016

Manufacturer: ZEISS

02 II Specifications

- Two-stage magnification providing resolution at a distance, enabling large, flexible working distances while maintaining submicron resolution.
- Direct visualization of 3D crystallographic grain orientation in a non-destructive tomography environment, with diffraction contrast tomography (DCT).
- Scout large samples to identify a region of interest (ROI), and then zoom to image targeted volumes at high resolution,
- Tunable propagation phase contrast to visualize low Z materials and biological samples that tend to have limited absorption contrast. (Fig. 3 and Fig. 4).

03 II Contact:

Oliver Focke
Faculty 4 – Production Engineering
TAB / 3.35
☎ +49 421 218 64582
✉ focke@uni-bremen.de
Location: LION
Principal Investigator: Lucio Colombi Ciacchi