

KNMF USER MEETING 2016

March 1-2, 2016 in Karlsruhe, Germany



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1. Report

The annual KNMF user meeting provides an ideal opportunity for users to meet with KNMF technology experts, discuss new ideas, learn of latest technology developments and of course to present results. In 2016, the KNMF held its first independent meeting which attracted a total of 73 participants. This is a growth in the number of attendees compared to the previous joint meetings with ANKA. Approximately 50% of the participants were from external organisations. The countries represented by the users matched the distribution seen in the user proposals that is 50% Germany, 25% other European countries and 25% rest of the world, that is, from countries as far afield as India, Canada and Australia. Two thirds of the external participants were registered users and one third non-users and as such potential new users. The in-house attendees came from eight institutes of KIT and reflected in-house users as well as technology experts.



The user meeting was opened by Prof. Blümer, head of Division 5 at KIT, and responsible for the KNMF. During his welcome speech he asked for how many this was the first KNMF user meeting, about 20 raised their hands which demonstrates that “KNMF lives” as Blümer said.

Following this Dr. Jürgen Mohr, head of KNMF, gave the report for the year 2015. KNMF offered with its 25 technologies about 60.000 machine hours; 170 user proposals have been accepted and about 160 papers have published or are in



preparation. A major change in the operation of KNMF in 2015 has been the adjustment to the closure of ANKA as a user facility; soft X-ray spectroscopy, microscopy and spectromicroscopy (WERA) has been transferred into the laboratory for microscopy and spectroscopy. X-ray microscopy and 3D tomographic imaging as well as Soft and medium-energy X-ray spectroscopy (X-SPEC) will also be offered as soon as the technologies have been fully installed. This ensures that it is still possible to access some synchrotron technologies. Mohr also described recent advances such as the capability for Edge Free Roll-to-Roll Endless Structuring which opens the possibility of e.g. printing structures designed for solar cell applications. A selection of highlights arising from user projects was presented relevant to a broad spectrum of marketable applications such as Dielectric Resonant Antenna Arrays by Deep X-ray lithography, Ultrafast Patterning of 3D Electrodes by laser processing, the Capture of Circulating Tumour Cells by Polymer Pen Lithography, the Characterization of the driving Mechanism of Molecular Motors by single crystal X-ray crystallography as well as reduced density mapping by TEM, a unique technological advance which allows the identification of local structural changes in the range of hundredth of Angström.

The opening session and following poster exhibition was well attended by 65 participants many of which had already attended the training courses.

The offer of training courses was a new feature to the user meeting in 2016. These were welcomed because the users were able to learn about specific capabilities of technologies which are beyond the sphere of the users' current expectations. Small groups meant that hands on experience could be gained, and that users could benefit from individual conversations with the experts. High interest in Direct Laser Writing led to two half day courses, and two courses in Polymer microfabrication focused on



the fabrication of shims used as masters for replication in the morning, whilst in the afternoon the focus was on the replication process itself. The course in Dip Pen Nano Lithography, a technique which enables the functionalisation of surfaces with molecular precision originally used for biological applications, and more recently for nano electronic components was also full to capacity.

The main part of the meeting saw 12 presentations by users, with six invited speakers and again more than 60 participants. The impact KNMF is making on application areas such as energy and health was well represented.

Dr. Susan Anson

(Photos by Thomas Schaller)



2. Report of the KNMF Advisory Committee (KUC)

KNMF User Committee Session, March 2, 2016

The KNMF User Committee represents the interests of all scientists who perform research at the Karlsruhe Nano Micro Facility (KNMF) of the Karlsruhe Institute of Technology (KIT). As an elected body representing all KNMF users, the KUC strives to enhance research opportunities at KNMF by providing a framework of communication between the KNMF Users and the KNMF management on all relevant matters. Within this mandate, the KUC, among others, organizes a User Committee Session at each User Meeting to receive feedback from current and recent users attending the meeting.

KUC members attending the User Meeting:

- Prof. Dr. Sven Achenbach, University of Saskatchewan, Saskatoon, Canada
- Prof. Dr. Florian Banhart, University of Strasbourg, Strasbourg, France
- Prof. Dr. Jost Goettert, Hochschule Niederrhein, Krefeld, Deutschland

Infrastructure

Several users as well as the committee stated the importance of keeping KNMF's infrastructure at an internationally competitive level in order to maintain KNMF's ability to attract highly recognized scientific users. This includes adding new capabilities not yet available in older equipment, renewing old equipment that starts to fail, and eliminating bottlenecks in current instrumentation:

Key technologies must be kept at the newest level to maintain KNMF's unique selling points and ultimately remain attractive for external users. Failing to do so would risk making KNMF less attractive, particularly as individual pieces of infrastructure are getting more commonly available at various universities. Long-term

planning for upgrading the infrastructure is of critical importance, and should be done with input from the expertise of the KNMF user base.

As an example, added TEM capabilities and new technologies in planar and three-dimensional micro and nano patterning are seen as a strategic priority to keep KNMF among the most important and relevant research infrastructures in Nano and Micro Technology fabrication and characterization, offering unique capabilities.

Long waiting times, as this is presently the case for users of the TEM facility, reduce the attractiveness of the KNMF and should be avoided by extending the equipment. Demand from the host institutions and external users might need to get balanced.

Some research was recently impeded by limited access to ANKA. Ongoing access to ANKA beam time as an integral part of KNMF proposals (e.g. when using X-ray lithography) is of high importance for KNMF, and some of the related techniques constitute unique selling points for KNMF.

Training

In response to past suggestions from the users, KNMF organized a series of workshops on the first day of the User Meeting. The workshops were well received, some overbooked, and participation extended beyond the expected group of attendees (Master's and Ph.D. students, Post Doctoral Fellows), including faculty from several countries.

Sizeable interest was identified to further intensify training and education at KNMF, even to the extent of offering extended summer schools or similar, where a week of intense work on and with a certain set of techniques could be offered, eventually including own samples. Such a course might even get implemented into European undergraduate and graduate education, offering ECTS credits.

User Meeting

Attending external users expressed a high degree of satisfaction with services obtained from KNMF, particularly the competency and diligence of KNMF staff.

It was recommended to maintain a two-half days format for upcoming User Meetings, but shift the start of the meeting earlier into the first day. This allows half a day of travelling in each direction, unless up-front training courses are taken advantage of.

Overseas users stressed the difficulties some colleagues had with obtaining visa for Germany. The importance of early announcements of User Meeting dates and subsequent issue of letters of invitation was stressed.

For the KNMF User Committee,

S. Achenbach

F. Banhart

J. Goettert

(Photo by Thomas Schaller)

3. Annex: Agenda

1st day - March 1, 2016

Morning & afternoon: Training Courses:

Secondary Ion Mass Spectrometry (SIMS) - Dr. Alexander Welle

9am - 3pm, building 321, room 316

Dip-Pen Nanolithography (DPN) - Dr. Dr. Michael Hirtz

Join the group at 10am in the foyer of building 640.

Direct Laser Writing (DLW) - Stefan Hengsbach

Join the group at 9am/1pm in the foyer of building 301.

Polymer Microfabrication 1: Manufacturing of Nickel Molds (Shims) - Dr. Markus Guttman

Join the group at 9am in the foyer of building 301.

Polymer Microfabrication 2: Micro Replication - Dr. Matthias Worgull

Course starts after lunch in building 307, room 322.

Building 640 (INT) – Lecture Hall and Foyer

16:00 Registration and setting up the posters

17:00 Welcome address (Prof. Dr. Dr. h.c. Johannes Blümer, Head of KIT Division V)

17:15 Introduction & KNMF status report (Dr. Jürgen Mohr, KNMF Director)

17:45 Poster session

18:30 Welcome reception and social event: wine presentation and wine tasting.

The wine tasting is partly sponsored by Softwareschneiderei (www.softwareschneiderei.de), our business partner for the KNMF Proposal System. During the evening event, you will have the opportunity to meet the developers. Take a look behind the scenes and leave your feedback!

2nd day - March 2, 2016

Building 640 (INT) – Lecture Hall

08:30 Registration

09:00 Opening

09:15 1st Session

10:45 Coffee Break

11:15 2nd Session

12:45 Lunch

14:00 KNMF User Committee Session

14:30 3rd Session

16:00 Closing Remarks

4. Annex: Sessions

Invited presentations are 25 minutes + 5 minutes discussion, all others 12+3 minutes

- 1st Session** Prof. Dr. Jörg Schneider, Technische Universität Darmstadt, Germany (invited)
Surface Characterization of Plasma Functionalized 3D Carbon Nanotube Arrays
- Tobias Reier, Technical University Berlin, Germany (invited)
Understanding the Origin of the Excellent Electrocatalytic Activity of Ir-Ni Mixed Oxides for the Oxygen Evolution Reaction
- Joachim Laun, Hasselt University, Belgium
Surface Grafting via Photo-induced Copper-mediated Radical Polymerization at Extremely Low Catalyst Concentrations
- Prof. Dr. Teodor Silviu Balaban, Aix Marseille University, France
Unravelling the supramolecular structure of porphyrin self-assemblies
- 2nd Session** Prof. Jyotsna Dutta Majumdar, Indian Institute of Technology Kharagpur, India (invited)
Laser Assisted Micro and Nano Topographical Modification of Ti-6Al-4V Surface and its Effect on Properties
- Prof. Andres Diaz Lantada, Universidad Politecnica de Madrid, Spain (invited)
Biomedical microdevices for interacting at a cellular level
- Prof. Dr. Sven Achenbach, University of Saskatchewan, Canada
Evaluation of Direct Laser Writing to pattern X-Ray Lithography Mask Templates
- PD Dr.-Ing. Stefan Helfert, FernUniversität in Hagen, Germany
Realization of a polarization converter using an array of hollow waveguides in a metallic film
- 3rd Session** Dr. Dirk Meyners, Christian-Albrechts-Universität zu Kiel, Germany (invited)
Magnetostriction: From a Side Effect to Application
- Daniela Stoeckel, Philipps-Universität Marburg / Justus-Liebig-Universität Gießen, Germany (invited)
Morphological Characterization of Hierarchically Structured Porous Solids by FIB-SEM & STEM Tomography
- Matthias Mail, University of Bonn, Germany
Biological and biomimetic superhydrophobic surfaces: Self-cleaning, air retention and other surprising innovations from nature
- ~~Prof. Dr. Edwin Fohrtung, New Mexico State University & Los Alamos National Laboratory, USA
Non-Linear Optical and Magneto-electric Effects across Interfaces~~

5. Annex: Posters

Aqeel Ahmad, Qureshi (Canada):

Novel Methods and Materials for Fabrication of RF Antenna Arrays using X-Ray Lithography Techniques

Eggl, Elena & Jud, Christoph (Germany):

Grating-based imaging at the Munich Compact Light Source (MuCLS)

Fejes, Peter (Australia): **Fabrication of a micro-scale optical element using direct laser writing**

Goossens, Katty (Belgium):

Osteoblast cellular microarrays on fibronectin micropatterns in microwells of microfluidic chips

Gromann, Lukas (Germany): **X-ray Dark-Field Imaging of Pulmonary Carcinoma**

Günther, Denise (Germany):

Combinatorial effects of patterned surface topography and chemistry of titanium based materials on plasma protein adsorption

Hoffmann, Rudolf (Germany):

Investigations on the metal distribution in amorphous indium zinc oxide phases for field effect transistors

Karpov, Dmitry (USA): **Nanoscale Mapping of Magneto Electric Phases Across Interfaces**

Koops, Hans Wilfried Peter (Germany):

Nano-granular composites with hyper giant current density capabilities at room temperature are produced with Focused Electron Beam Induced Processing

Kunka, Danays (Germany): **Generating Innovations in X-ray Imaging**

Lu, Ping (United Kingdom):

Directional friction control under mixed lubrication using regular anisotropic asperities

Mail, Matthias (Germany):

AFM imaging on superhydrophobic surfaces – a new way to investigate air layers under water

Piotter, Volker (Germany): **Recent progress in micro injection moulding**

Rieger, Jens (Germany): **Optimization of a Talbot-Lau grating interferometer**

Verre, Andrea Francesco (United Kingdom):

Large-scale multiplex functionalization of graphene using dip-pen nanolithography

Viermetz, Manuel (Germany): **High Resolution Laboratory Grating-Based X-Ray Phase-Contrast CT**

Willaert, Ronnie (Belgium):

Osteoblast cellular microarrays on fibronectin micropatterns in microwells of microfluidic chips

Yaroshenko, Andre (Germany):

Phase-Contrast X-Ray Imaging using a Modified Clinical Mammography System