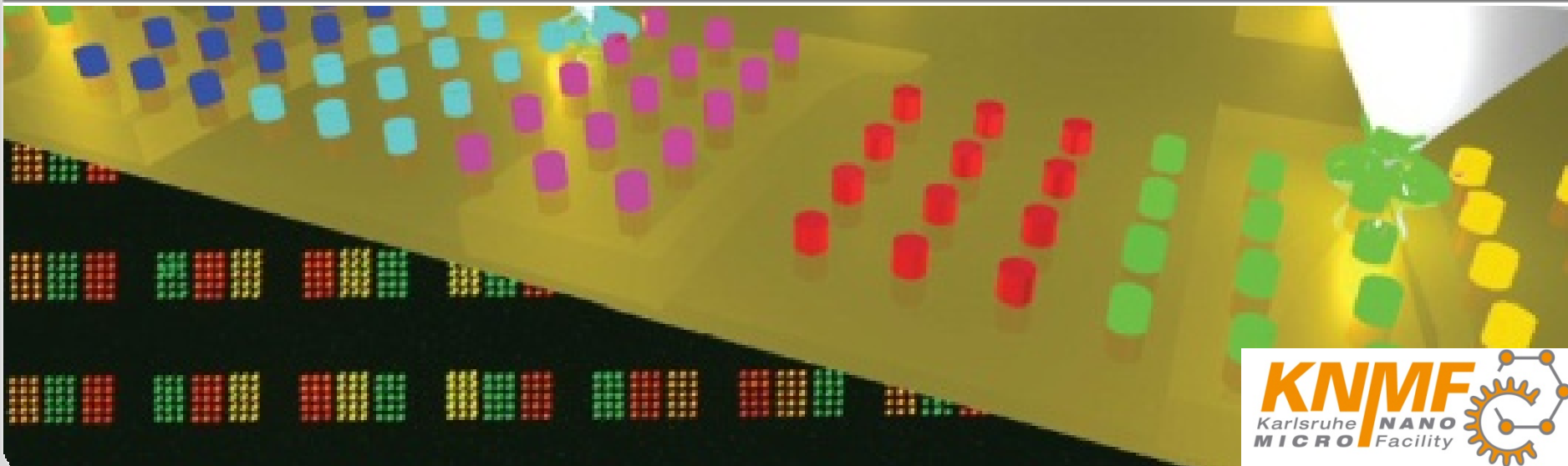


Karlsruhe Nano Micro Facility (KNMF)

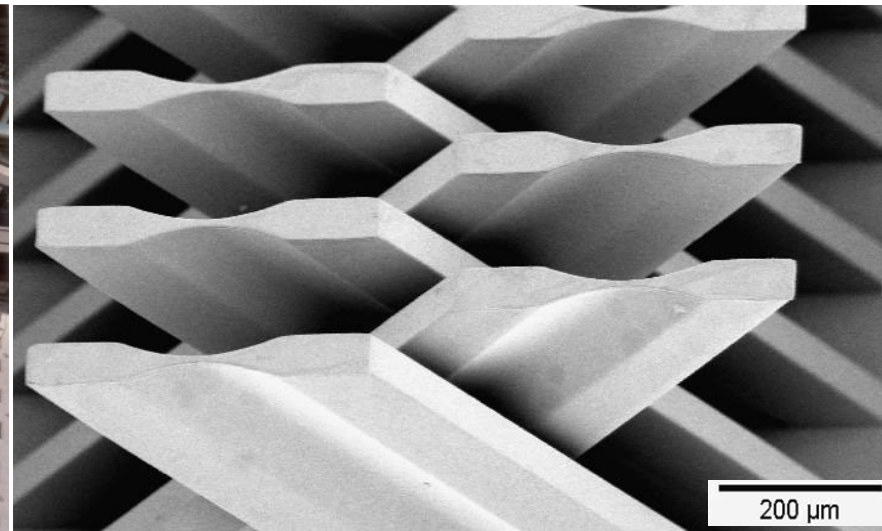
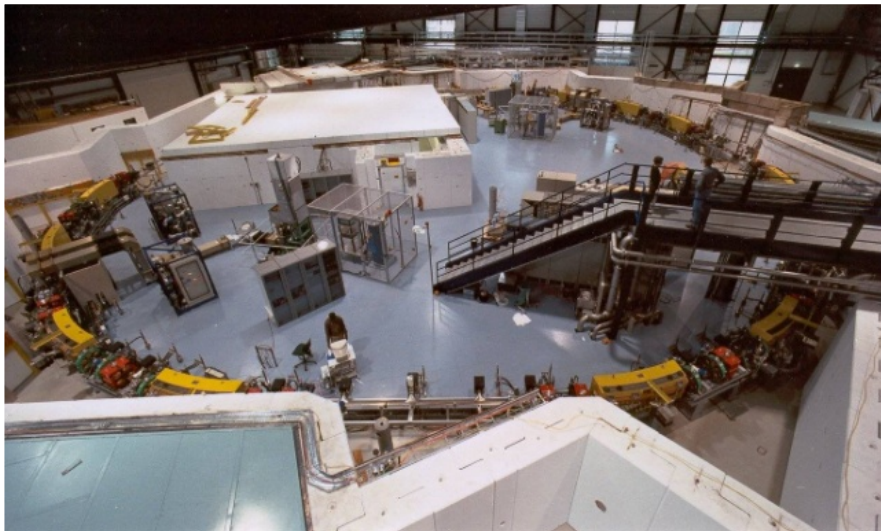
Facilitating Innovation in Advanced Multimaterial Micro Nano Technologies

Helmholtz Programme NANOMICRO: Science, Technology, Systems



Content

- About us
- Technologies
- Proposal submission
- Status
- Summary



Karlsruhe Nano Micro Facility

- Helmholtz research infrastructure
- state-of-the-art technologies and expertise
- micro nano structuring and characterising
- multitude of functional materials
- free-of-cost access to users from industry and academia

**→ free-of-cost access
to multimaterial processing in MNT**

Laboratories

1. KNMF Lab for Micro and Nanostructuring (2007)

2. KNMF Lab for Microscopy and Spectroscopy (2008)

3. KNMF Lab for Synchrotron Characterisation (2010)



Technologies & Expertise

Micro- & Nanostructuring

Electron beam lithography

Deep X-ray lithography

Laser material processing

Injection moulding

Hot embossing

Focused ion beam

Dip pen nanolithography

Thin film technologies

Atomic layer deposition

Dry etching cluster

Nanoimprint lithography

Microscopy & Spectroscopy

Scanning electron microscopy

Transmission electron microscopy

X-ray photoelectron spectroscopy

Auger electron spectroscopy

Bulk and trace analysis

Electron probe micro analysis

Laser ablation ICPMS

Thin film characterisation

Atomic force microscopy cluster

Atom probe tomography

NMR spectroscopy

Scanning probe technologies

Synchrotron Characterisation

Photo emission microscopy

In-situ XRD

X-ray microscopy & tomography

Small Angle Scattering

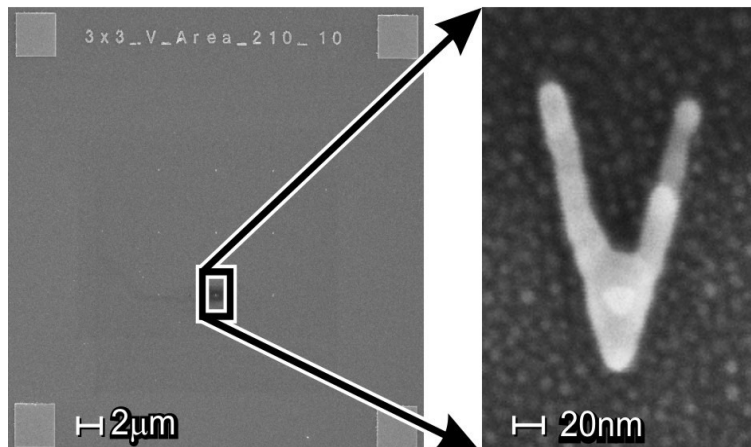
X-ray diffraction

In-situ powder X-ray

IR Near Field Microscopy

subject to a
mayor investment

Electron Beam Writing & Scanning Electron Microscopy

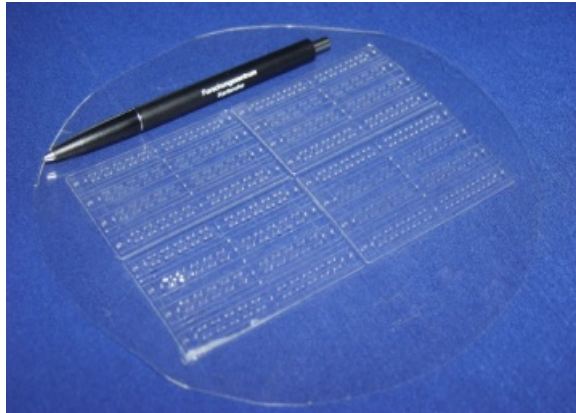


SEM image of a 3 x 3 array of “V”-structures. “V”-structure 106 times magnified. The left and right leg width is 16 nm and 18 nm

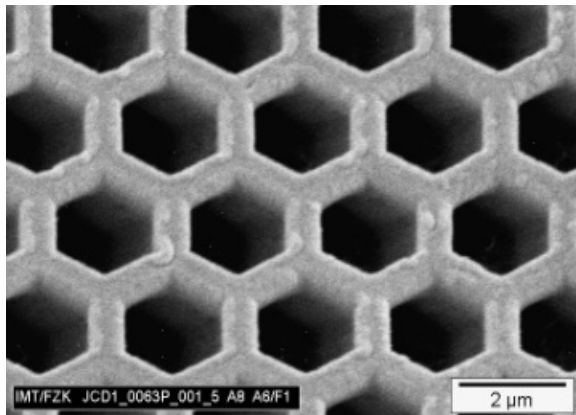
Some Figures

- **Substrates:** 4” and 6” wafer
- **Resolution:** < 1 nm
- **Aspect ratios:** up to 10 (geometry)
- **Structural details:** down to 20 nm (resist thickness < 100 nm)
- **Resist thickness:** extremely thick PMMA (3200 nm) with structural details in the submicron range (~ 200 nm)
- **Mix & match with other technologies at KNMF** (FIB, DPN, X-ray, ...)

Hot Embossing



Microstructures on a 8 inch molding area

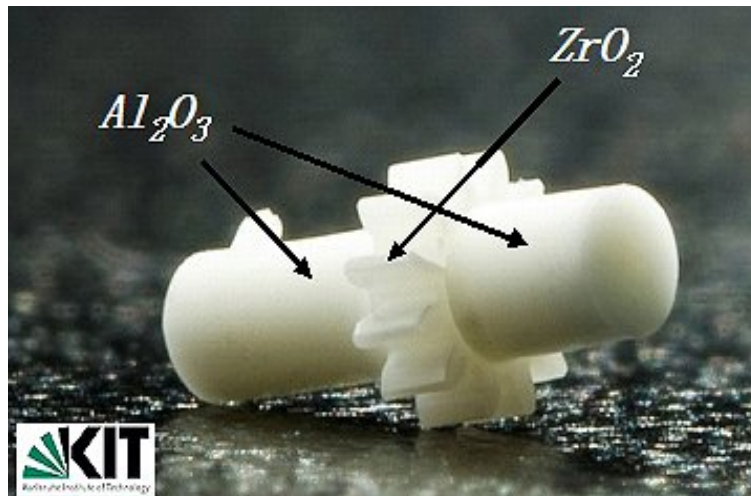


Optical grating structures in the ~300 nm range

Some Figures

- **Molding areas:** up to 8 inch
- **Cycle times:** 6 min – 20 min
- **Molding of many thermoplastic polymers:** including high temperature polymers (e.g. PEEK)
- **Nanoimprint:** structure size down to the sub-micro range
- **Double sided molding**
- **Molding of through holes**

Injection Moulding

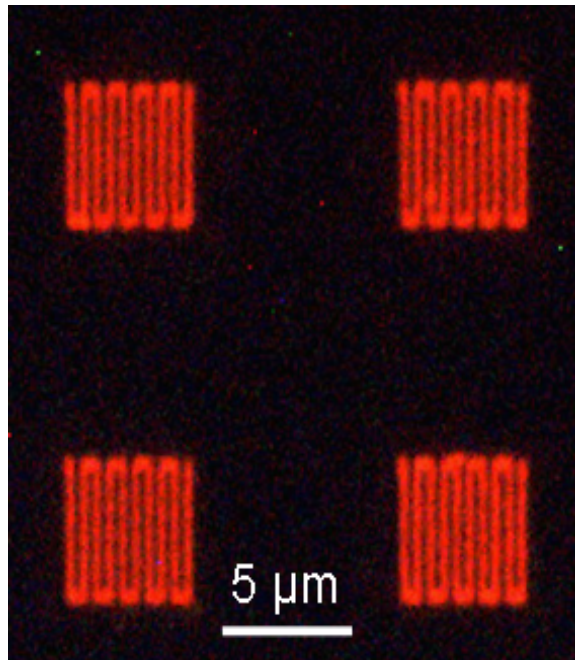


Combined gearwheel / shaft
 sample made by 2C injection
 moulding of alumina (shaft)
 and zirconia ceramic (gearwheel)

Some Figures

- **Substrates:** polymer, metal, ceramic
- **Cycle times:** < 5 s – 6 min
- **Aspect ratios:**
 - 17 for free standing structure
 (height: 2000 μm , width: 115 μm)
 - 25 for buried structure
 (height 250 μm , width: 10 μm)
- **Structural details:**
 < 200 nm for AR = 1
 (in case of lower AR replication
 minima decrease correspondingly)

Dip Pen Nanolithography



Fluorescently labeled phospholipids patterned on a polystyrene surface with a half-pitch of 250 nm

Some Figures

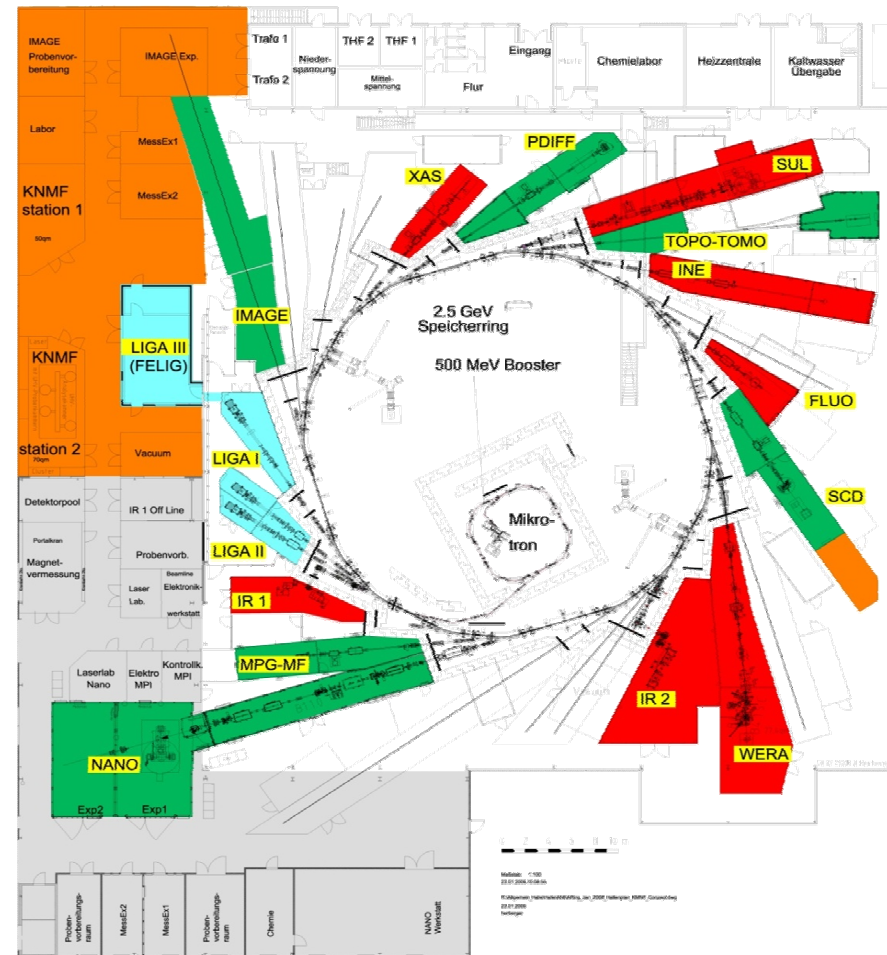
- **Smallest structural detail:** < 100 nm
- **Largest structural detail:** > 10 μm
- **Substrates:** glass, silicon, PMMA, polystyrene, metals (e.g. Au, Ti)
- **Compatible with biological molecules:** e.g. DNA, protein & phospholipids
- **Compatible with prestructured surfaces**
- **No undercuts**

Synchrotron Light for MNT

Challenges

Developing the next generation of synchrotron technologies for in-situ characterisation of micro- and nano-scale functional materials

- X-ray lithography
- Spectroscopy
- X-ray scattering & imaging
- KNMF



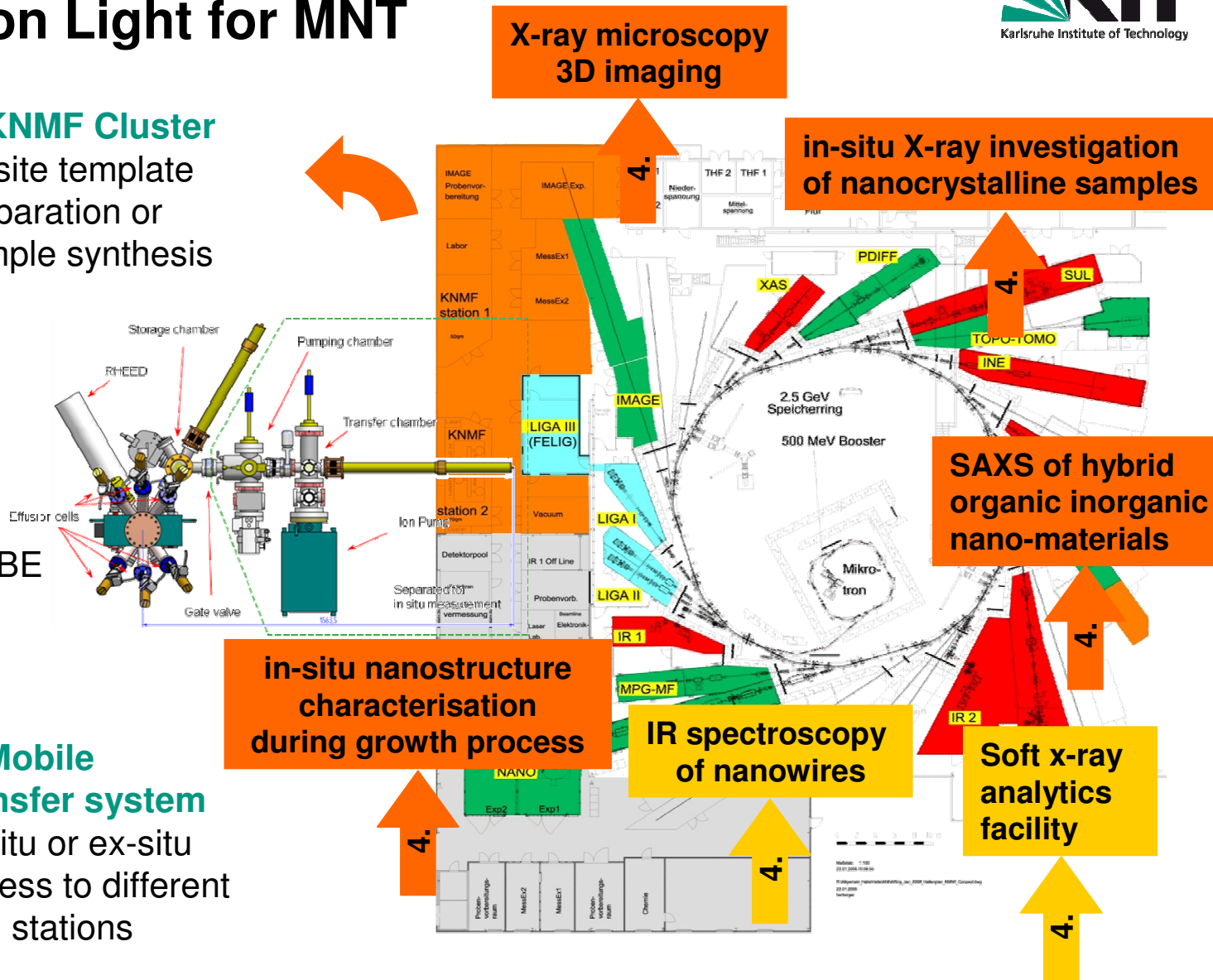
Synchrotron Light for MNT

1. KNMF Cluster
on-site template preparation or sample synthesis

2. In-vacuo processing with modular components

- in-situ CVD
- in-situ sputtering
- in-situ / ex-situ MBE
- in-situ PLD
- etc. (extendable)

3. Mobile transfer system
in-situ or ex-situ access to different end stations



**X-ray microscopy
3D imaging**

**in-situ X-ray investigation
of nanocrystalline samples**

**SAXS of hybrid
organic inorganic
nano-materials**

**in-situ nanostructure
characterisation
during growth process**

**IR spectroscopy
of nanowires**

**Soft x-ray
analytics
facility**

Proposal Submission

Free of Cost

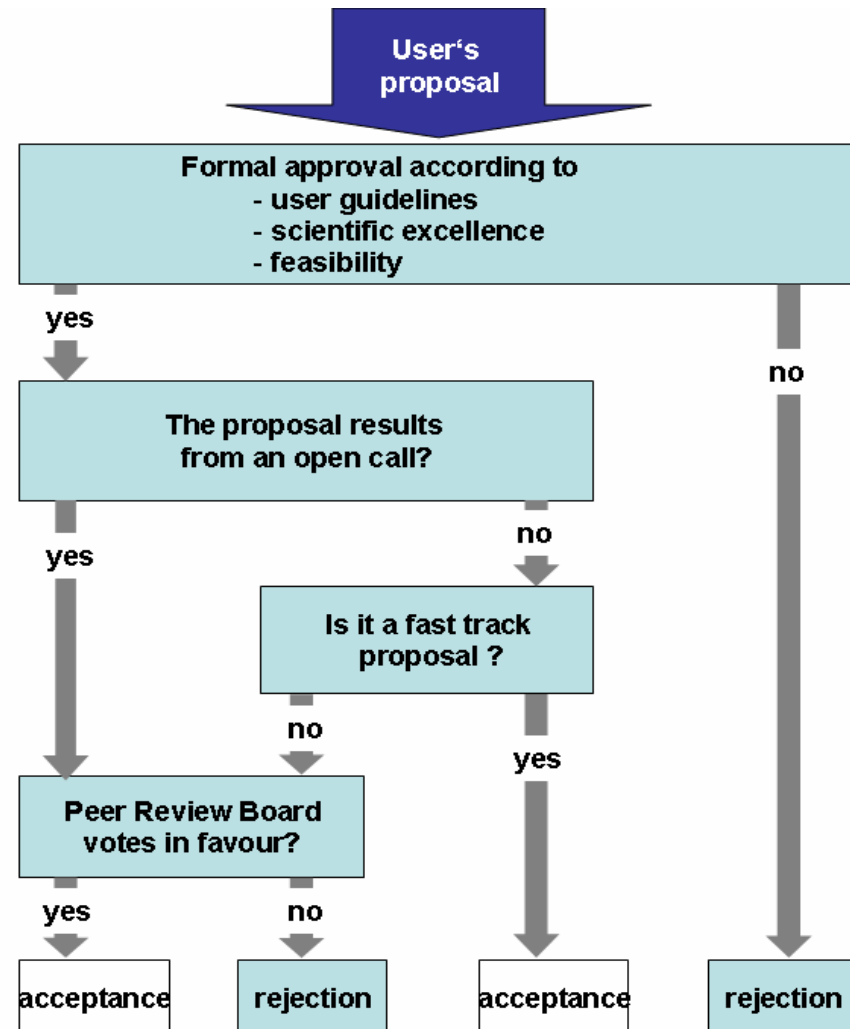
- standard proposal
- long term proposal
- fast track proposal

Annual Calls

- January 15
- June 30

Submission

- www.kit.edu/knmf



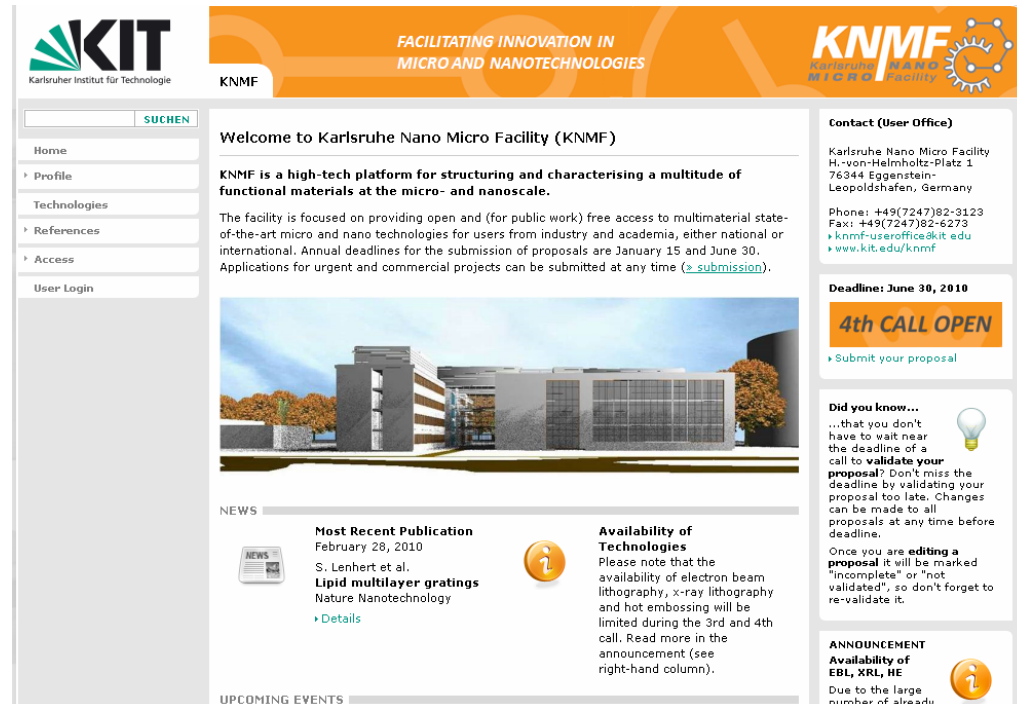
Proposal Submission

Full Cost Recovery

- proprietary proposal
 - ➔ no publications
 - ➔ no deadlines
 - ➔ no peer review

Submission

- www.kit.edu/knmf



The screenshot shows the homepage of the Karlsruhe Nano Micro Facility (KNMF). The header features the KIT logo and the KNMF logo with the tagline "FACILITATING INNOVATION IN MICRO AND NANOTECHNOLOGIES". The main content area includes a welcome message, a search bar, and a navigation menu. A prominent orange banner announces the "4th CALL OPEN" with a deadline of June 30, 2010. Below this, there is a "Did you know..." section with a lightbulb icon and an "ANNOUNCEMENT" section with an information icon. The "Most Recent Publication" section highlights a paper by S. Lenhart et al. on "Lipid multilayer gratings" in Nature Nanotechnology. The "Availability of Technologies" section provides details on the facility's capabilities and upcoming events.

User Information

- Facility
- Expertise
- Technologies
- User Guidelines
- Access conditions
- Proposal submission

→ www.kit.edu/knmf



Current Status



KIT
Karlsruhe Institute of Technology

Call for Proposals

Karlsruhe Nano Micro Facility

KNMF is a high-tech platform for structuring and characterising a multitude of functional materials at the micro- and nanoscale. It is operated as a Helmholtz large-scale user facility with open access to its state-of-the-art installations and processes on a proposal base. Successful proposals will be selected by peer review.



KNMF laboratory for micro- and nanostructuring



KNMF laboratory for microscopy and spectroscopy



KNMF laboratory for synchrotron characterisation

Deadlines: Jan. 15 / Jun. 30, 2010

Applications for particularly urgent projects can be submitted any time.
Contact: +49 7247 82-6188 • knmf-useroffice@kit.edu • www.kit.edu/knmf

KARLSRUHE NANO MICRO FACILITY

KNMF
Karlsruhe NANO MICRO Facility

DF - The Cooperative of Forschungszentrum Karlsruhe GmbH and Universität Karlsruhe (UK)

Forschungszentrum Karlsruhe
an der Helmholtz-Gemeinschaft

Universität Karlsruhe (TH)
Karlsruhe University • Founded 1724

Start-Up Phase

2009 – 2014

2009 – Actual

- 22 technology processes
- 35 technology experts

- 72 submitted proposals
- 99 requested technologies

- 70% approval percentage

Summary

KNMF

- operates as a large-scale user facility
- offers a unique and dedicated set of state-of-the-art technologies for multimaterial processing in MNT
- has a high relevance for NANOMICRO
- enhances the competitiveness of its partners and users

You are invited to submit your proposal!

next deadline: June 30, 2010

Contact



Karlsruhe Nano Micro Facility
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen
Germany

knmf-useroffice@kit.edu
www.kit.edu/knmf



**You are invited
to submit your
proposal!**

June 30, 2010



History of KNMF



- 2009** Positive Recommendation by PoF-II Panel
- 2008** Proposal for EU infrastructure EUMINAfab approved (KNMF is coordin.)
KNMF opening
HGF Senate approves funding but contingent on PoF-II Panel Recomm.
International reviewers recommend approval of KNMF (“outstanding”)
- 2007** New proposal submitted to HGF
Approval of proposal by FZK Supervisory Board
New e-beam facility installed
- 2006** Approval of concept by “Perspective Commission”
First proposal for investment (Lack resources in Key Technologies)
Benchmarking study EVA_1
- 2004** HGF-Review: Recommendation for “Nanofabrication Facility”

Future of KNMF



- 2014*** Proposal on KNMF-II based on experience/success of 2009-2014 period
KNMF full user operation $\geq 50\%$
- 2011*** Joint acquisition of equipment with programme BioInterfaces
KNMF Laboratory for Synchrotron Characterization added
- 2010*** Additional equipment through HGF major investment funding mechanism

* subject to internal HGF processes