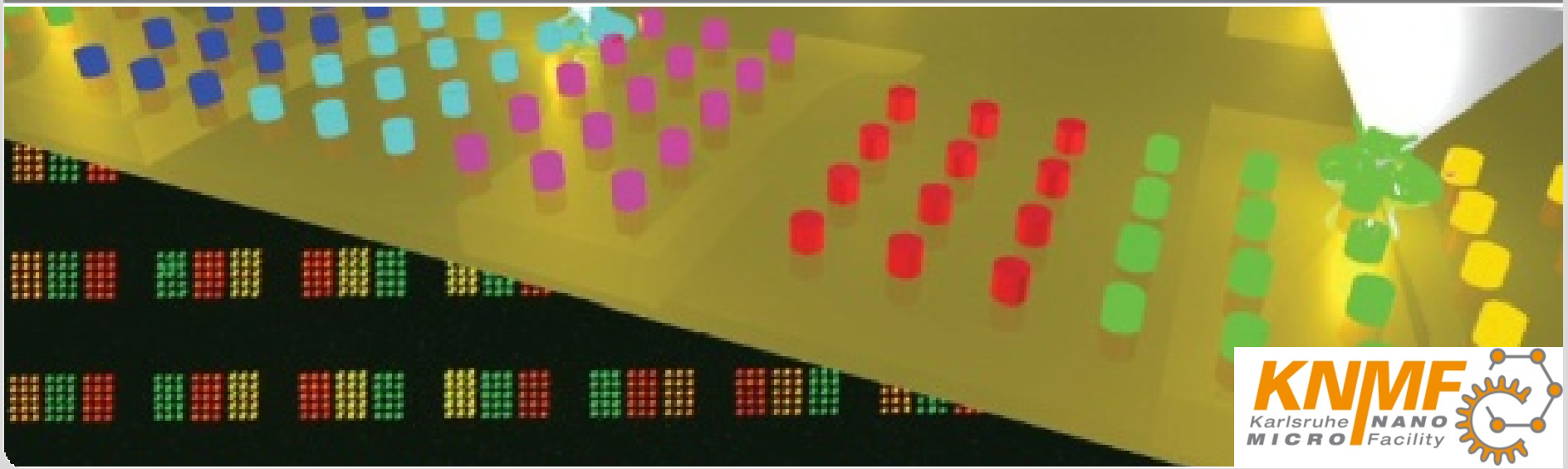
Karlsruhe Institute of Technology

Karlsruhe Nano Micro Facility (KNMF)

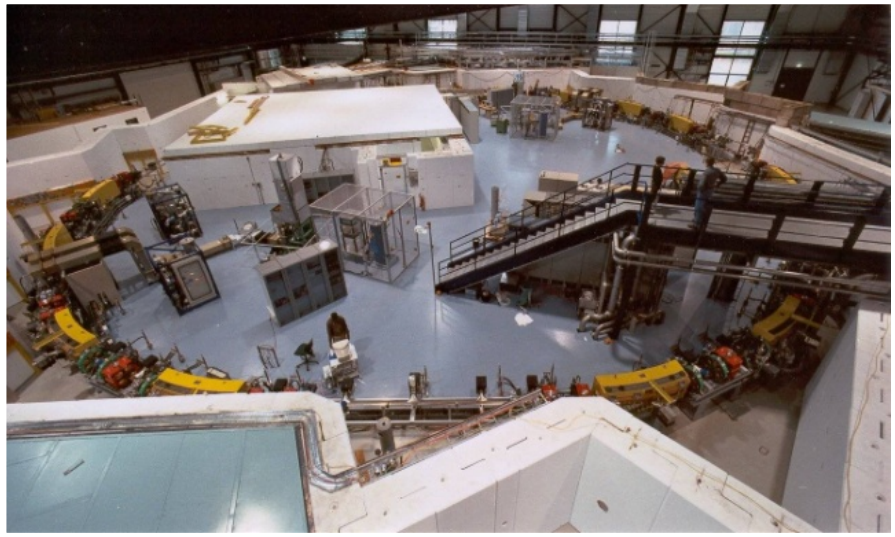
Facilitating Innovation in Advanced Multimaterial Micro Nano Technologies

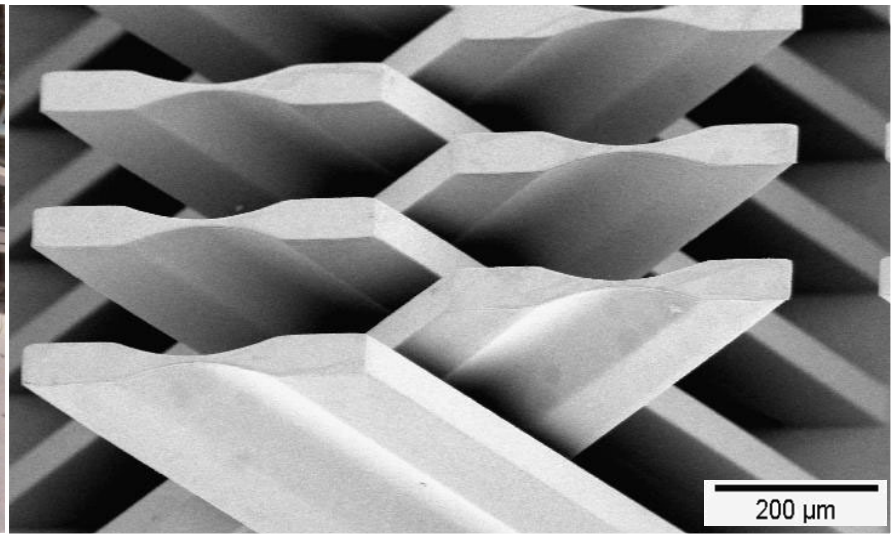
Helmholtz Programme NANOMICRO: Science, Technology, Systems



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

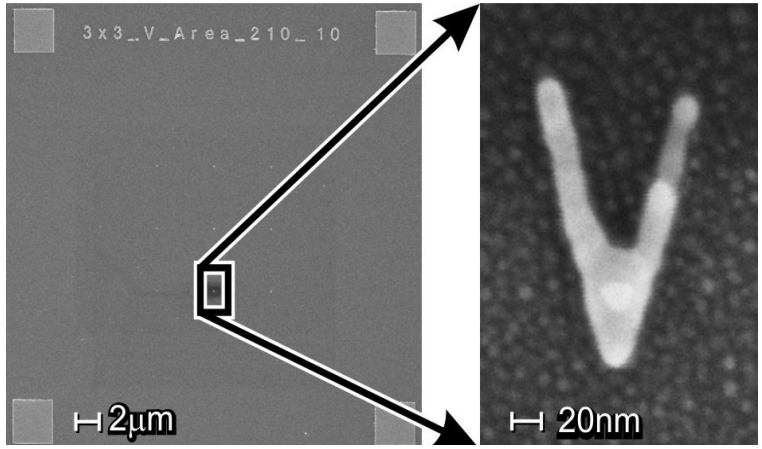
1. KNMF Lab for Micro and Nanostructuring (2007)
2. KNMF Lab for Microscopy and Spectroscopy (2008)
3. KNMF Lab for Synchrotron Characterisation (2010)

Technologies & Expertise

Micro- & Nanostructuring	Microscopy & Spectroscopy	Synchrotron Characterisation
Electron beam lithography	Scanning electron microscopy	Photo emission microscopy
Deep X-ray lithography	Transmission electron microscopy	In-situ XRD
Laser material processing	X-ray photoelectron spectroscopy	X-ray microscopy & tomography
Injection moulding	Auger electron spectroscopy	Small Angle Scattering
Hot embossing	Bulk and trace analysis	X-ray diffraction
Focused ion beam	Electron probe micro analysis	In-situ powder X-ray
Dip pen nanolithography	Laser ablation ICPMS	IR Near Field Microscopy
Thin film technologies	Thin film characterisation	
Atomic layer deposition	Atomic force microscopy cluster	
Dry etching cluster	Atom probe tomography	
Nanoimprint lithography	NMR spectroscopy	
	Scanning probe technologies	

subject to a mayor investment

Electron Beam Writing & Scanning Electron Microscopy

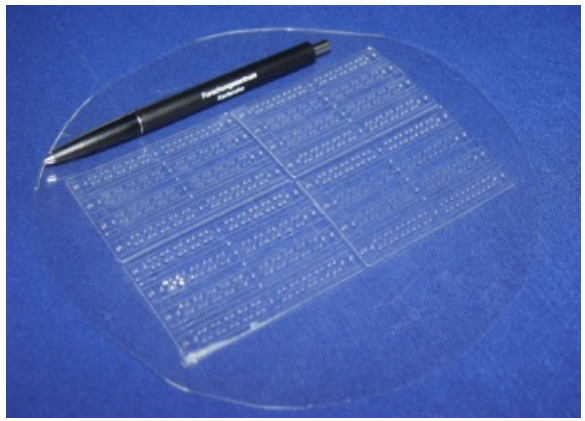


SEM image of a 3 x 3 array of ‘‘V”-structures. ‘‘V”-structure 106 times magnified. The left and right leg width is 16 nm and 18 nm

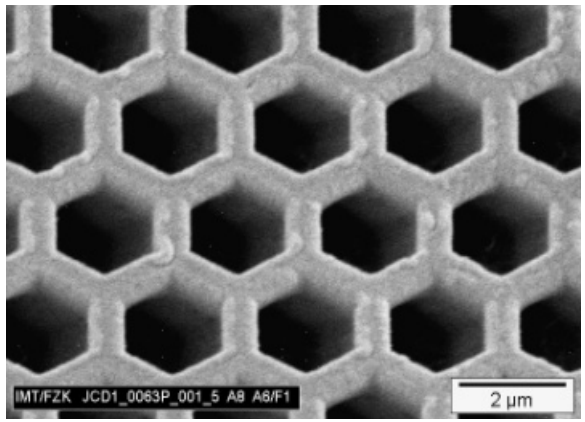
Some Figures

- **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

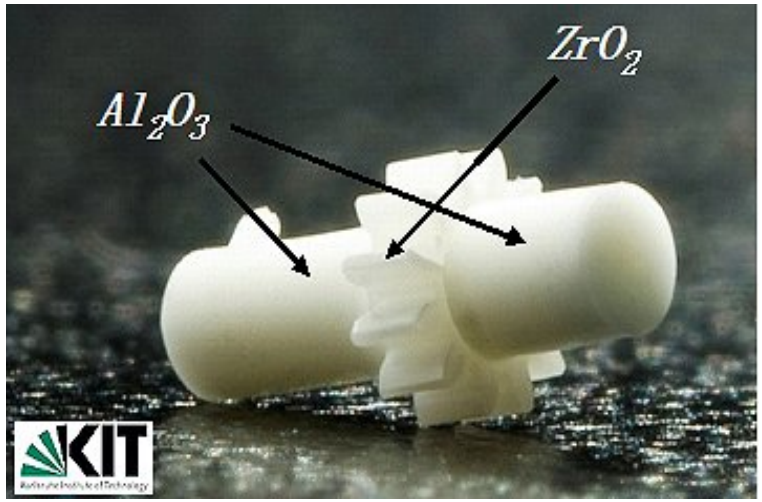


Optical grating structures in the ~300 nm range

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

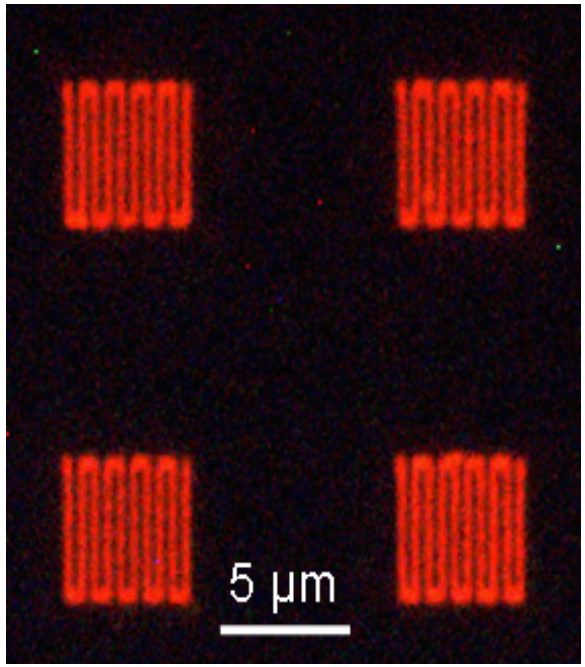


Combined gearwheel / shaft sample made by 2C injection moulding of alumina (shaft) and zirconia ceramic (gearwheel)

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 Nanolithograhpy



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

Some Figures

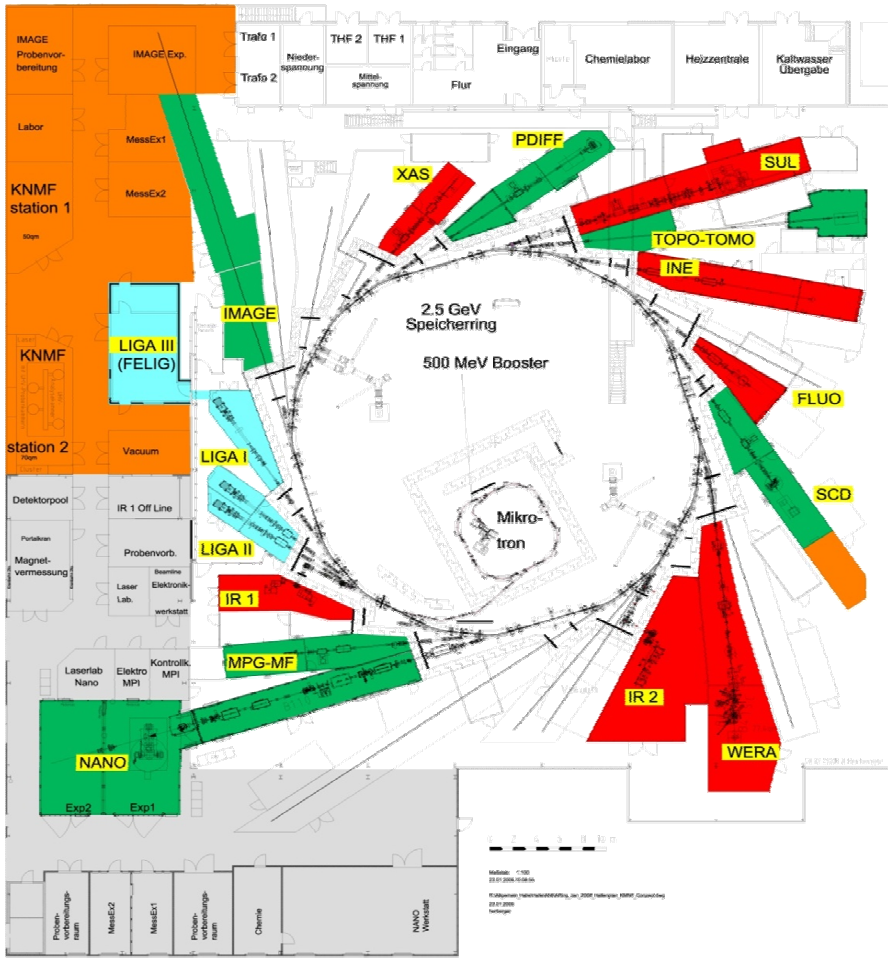
- **Smallest structural detail**: < 100 nm
- **Largest structural detail:** > 10 µm
- **Substrates**: glass, silicon, PMMA, polystyrene, metals (e.g. Au, Ti)
- **Compatible with biological molecules:** e.g. DNA, protein & phospholipids
- **Compatible with prestructured surfaces**
- **No undercuts**

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

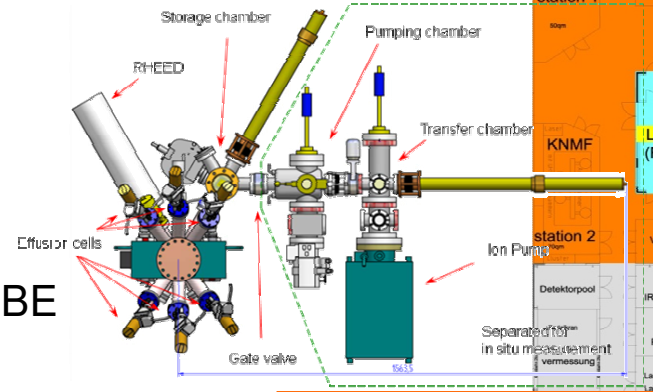


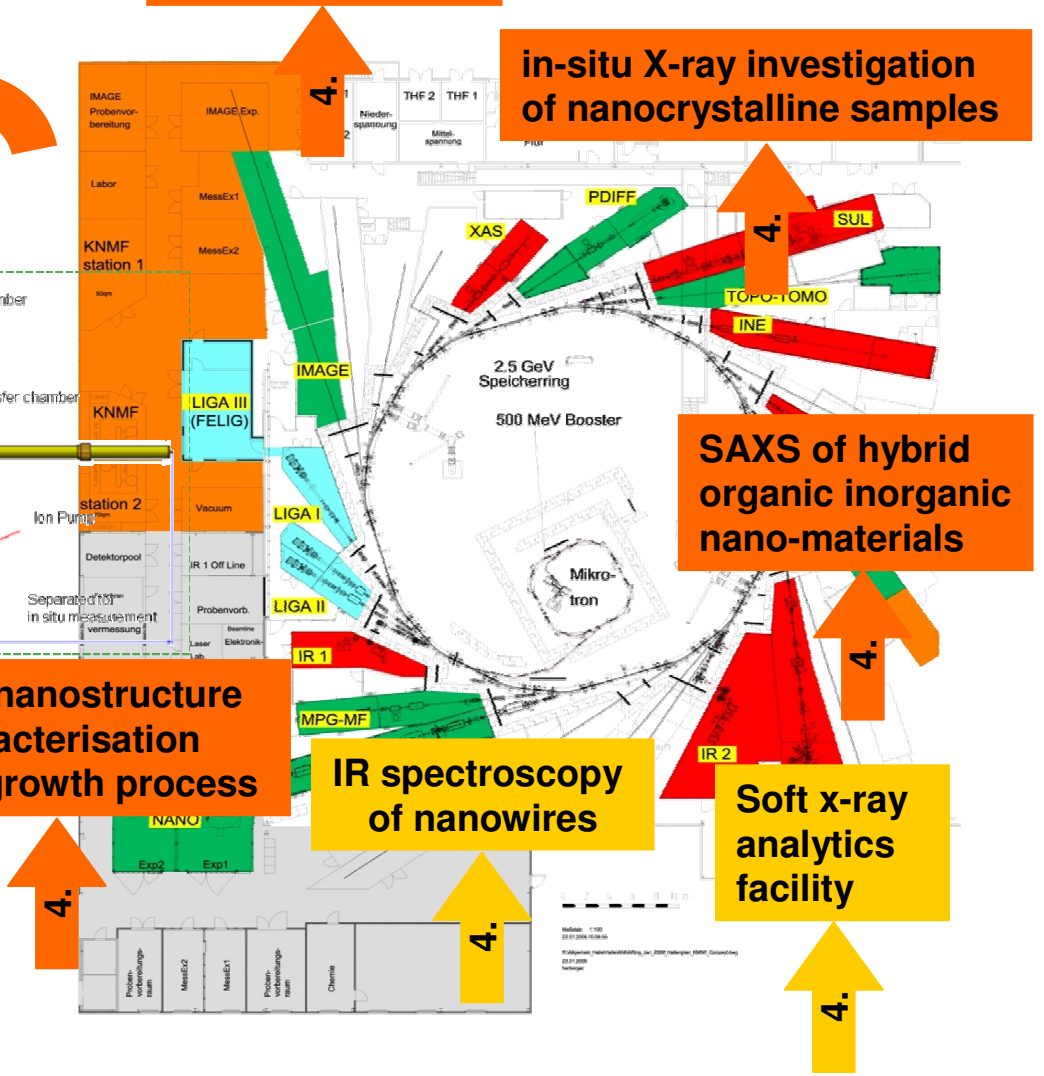
Synchrotron Light for MNT

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





Proposal Submission

Free of Cost

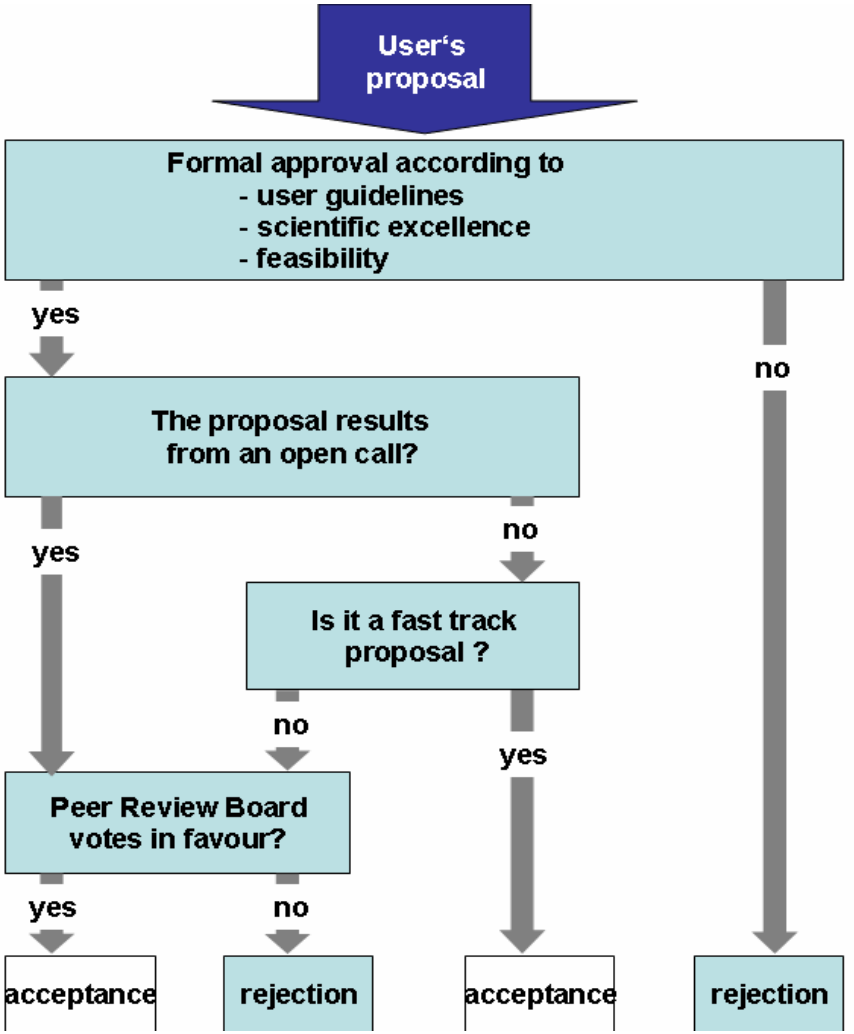
- standard proposal
- long term proposal
- fast track proposal

Annual Calls

- January 15
- June 30

Submission

- www.kit.edu/knmf



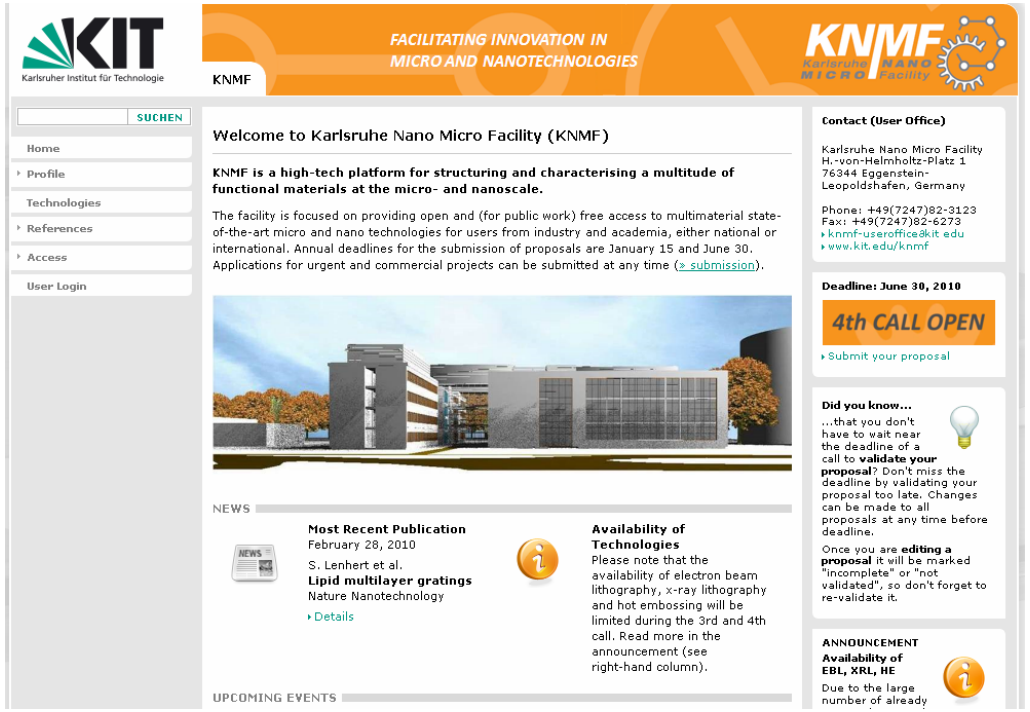
Proposal Submission

Full Cost Recovery

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

Submission

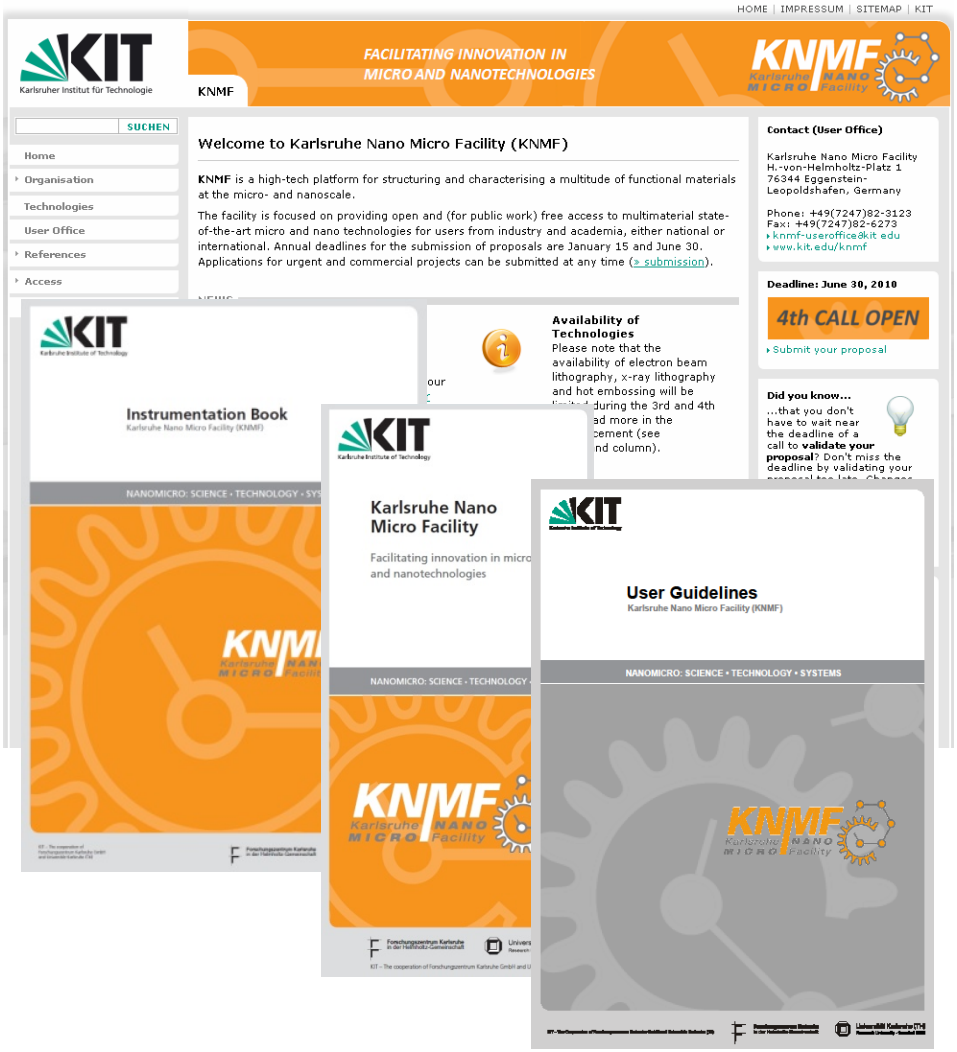
- www.kit.edu/knmf



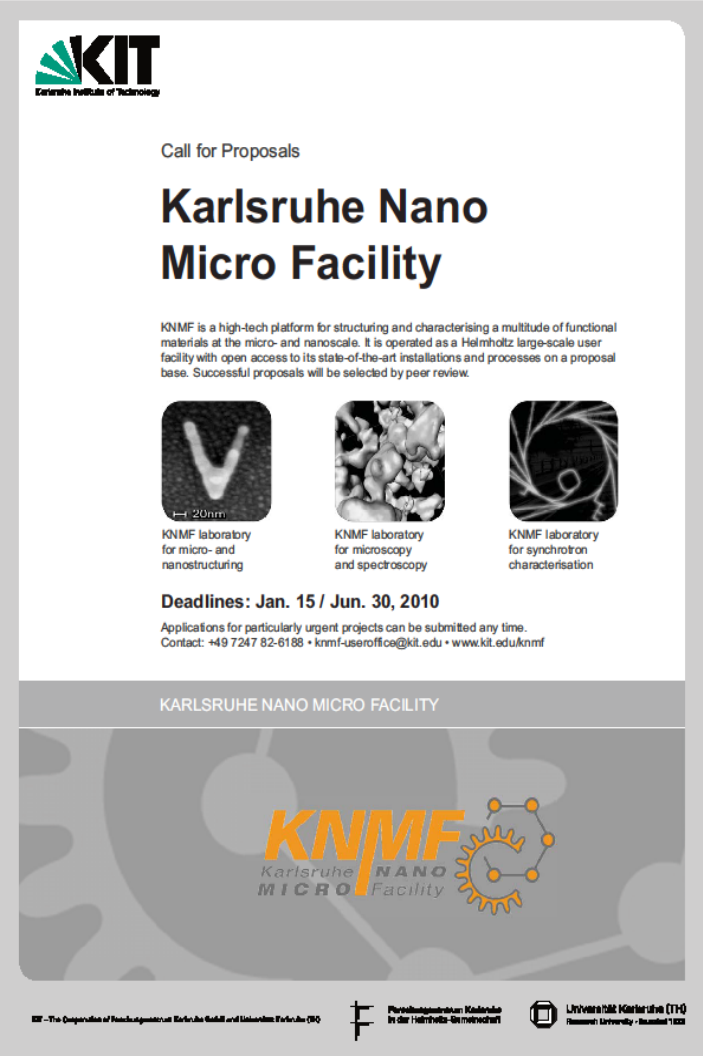
User Information

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

➔ **www.kit.edu/knmf**



Current Status



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

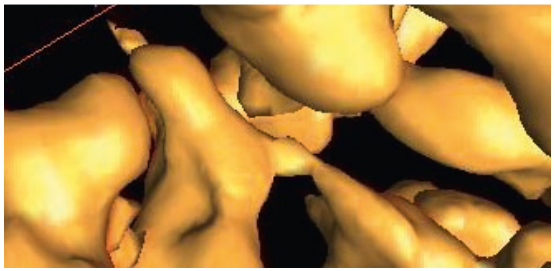
Contact

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 ≥ 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