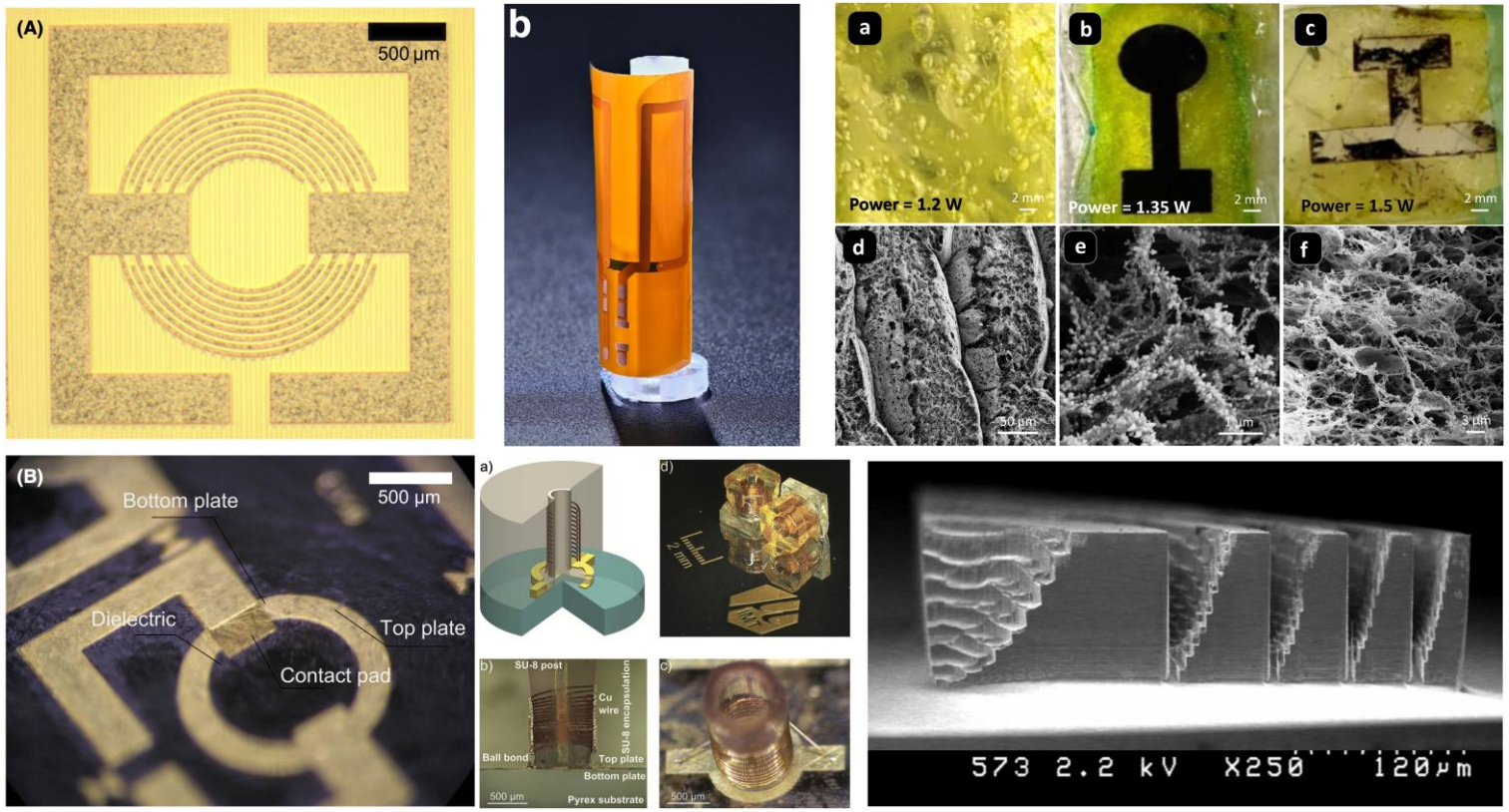
Introduction to Microsystem Technologies

Übersicht / Overview (-->*Keywords*)

- Definition and scope
- Relationship with microelectronics
- Basic fabrication techniques
- MST materials
- Physical principles at the microscale
- applications in consumer electronics, automotive systems, medical technology, and scientific instrumentation.

Zusatzinformation / Further Info.

- Selected key publications from leading scientific journals are discussed to highlight state-of-the-art developments
- includes examples from the personal research experience of the tutors, projects and journal papers from Prof. Jan Korvink and Dr. Vlad Badilita

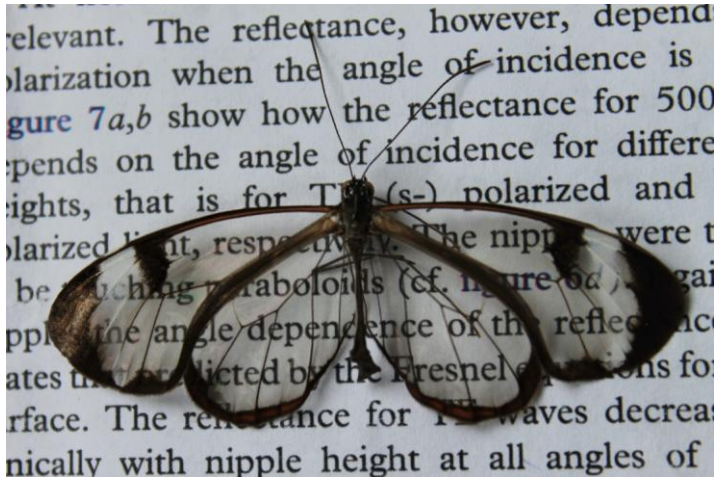


Einführung in die Bionik

Themenübersicht

- Baubionik
- Schwarmintelligenz
- Bionische Oberflächen
- Haftstrukturen
- Robotik
- Strukturelle Farben
- Sensorik

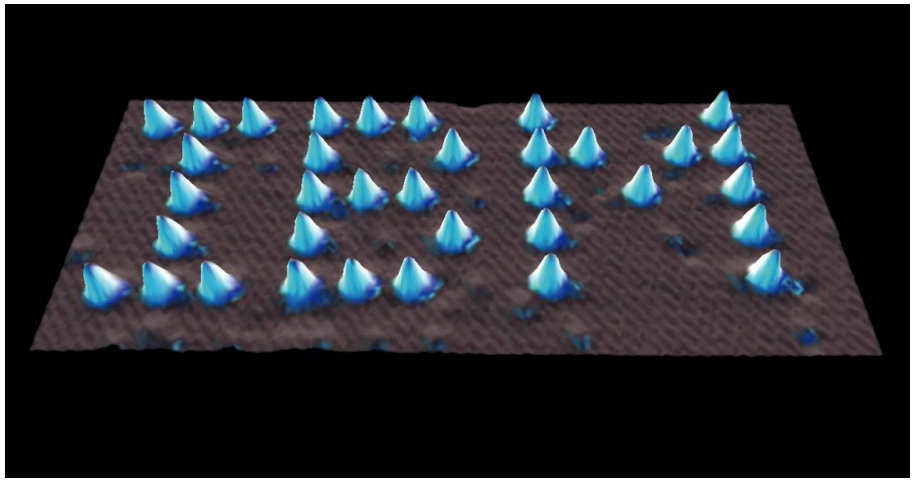
Die Bionik umfasst 2 SWS und findet 2026 zum letzten Mal im Sommersemester statt, ab 2027 jeweils im Wintersemester.

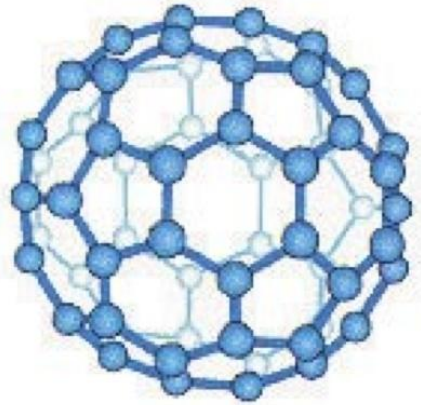


Einführung in die Nanotechnologie

Themenübersicht

- Raster-Sonden-Methoden
- Nano- und Mikrofabrikation
- Nanotribologie
- Atomare Kräfte
- Nanomaterialien





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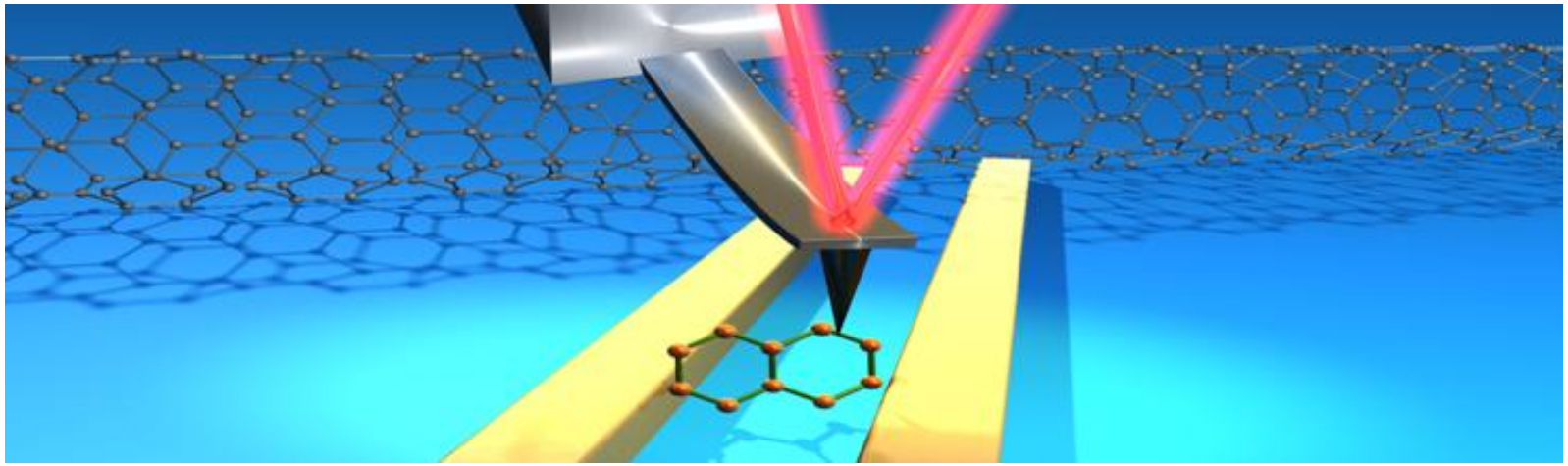
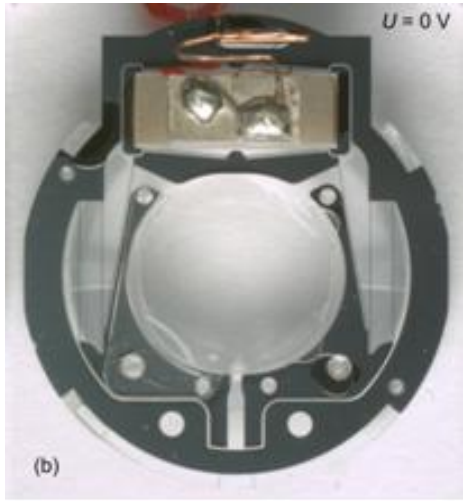
Die Vorlesung umfasst 2 SWS und findet 2026 zum letzten Mal im Sommersemester statt, ab 2027 jeweils im Wintersemester.



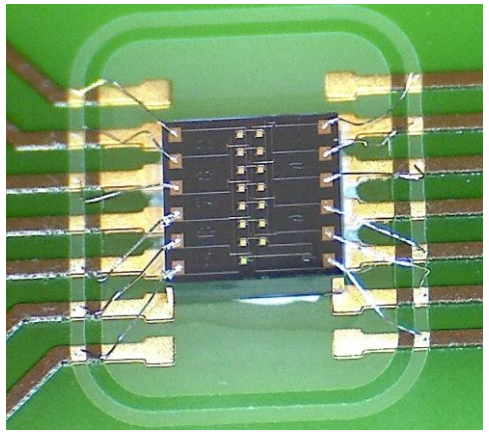
System integration in micro- and nanotechnology I

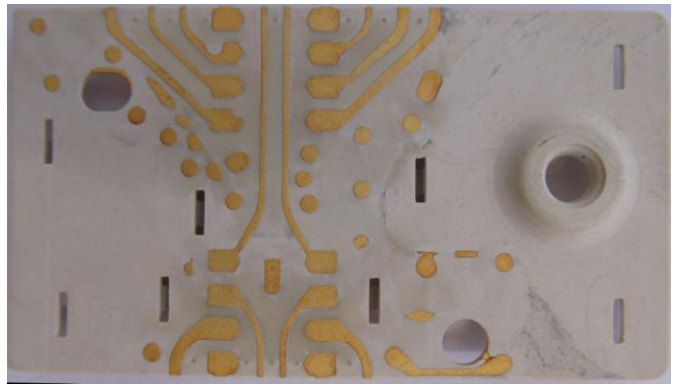
IAI

- Introduction to system integration
- Brief introduction to MEMS processes
- Flexure hinges
- Surface properties and plasma surface treatment
- Technical adhesive bonding
- Electronic mounting techniques
- Molded Interconnect Devices (MID)
- Functional printing
- Low Temperature Cofired Ceramics (LTCC)



The lecture will be illustrated with sample parts that are passed around





System integration in micro- and nanotechnology II

IAI

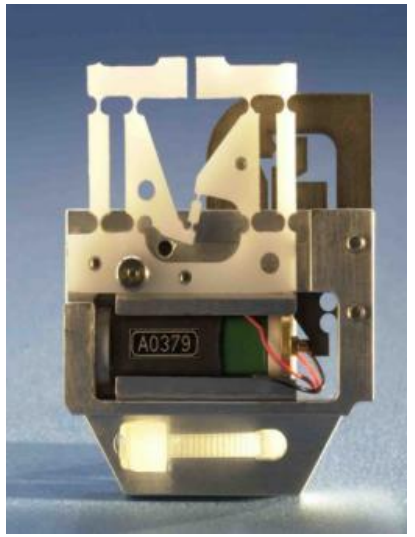
Introduction to system integration

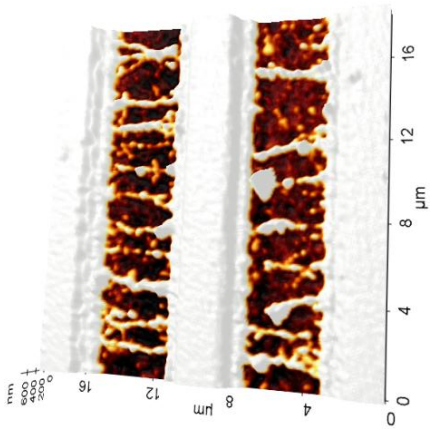
Integration technologies

- 2.5/3D integration in semiconductor and microsystems technology
- Packaging
- Direct laser writing (two-photon lithography)
- Microassembly
- Self-assembly

Applications

- Lab-on-chip systems
- Photonics
  - ✧ Micro-optics
  - ✧ Fibre optics
  - ✧ Silicon photonics





The lecture will be illustrated with sample parts that are passed around

KIT

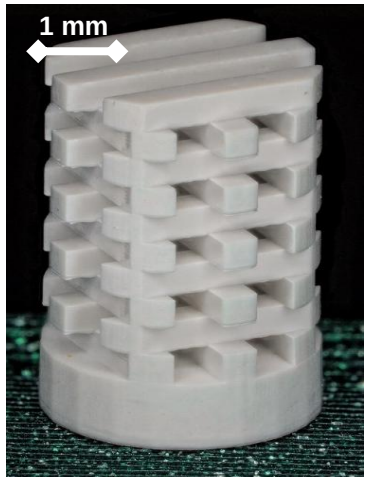
Miniaturisierte Wärmeübertrager 2142880/ Miniaturized Heat Exchangers 2142880

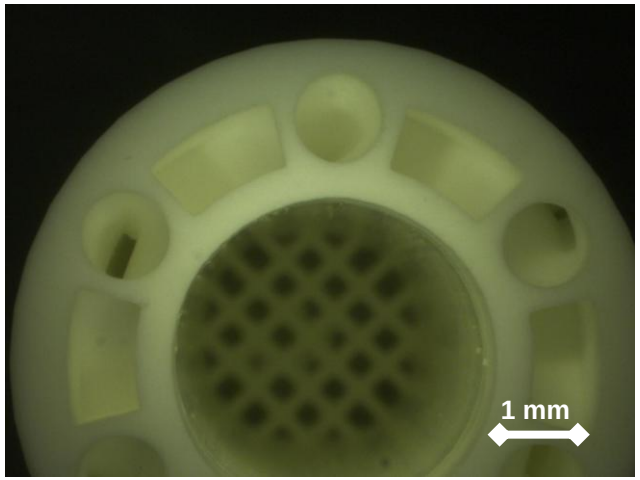
Übersicht / Overview

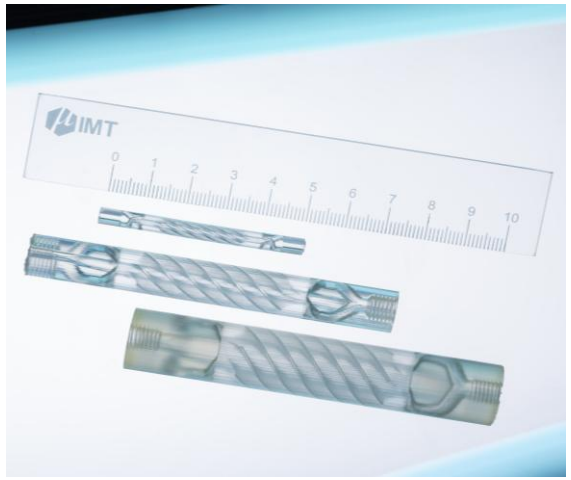
- Fundamentals of Heat Transfer
- Calculation Methods
- Types of Heat Exchangers
- Micro-Manufacturing
- Measurement and Control
- Materials, Systems and Devices
- Applications

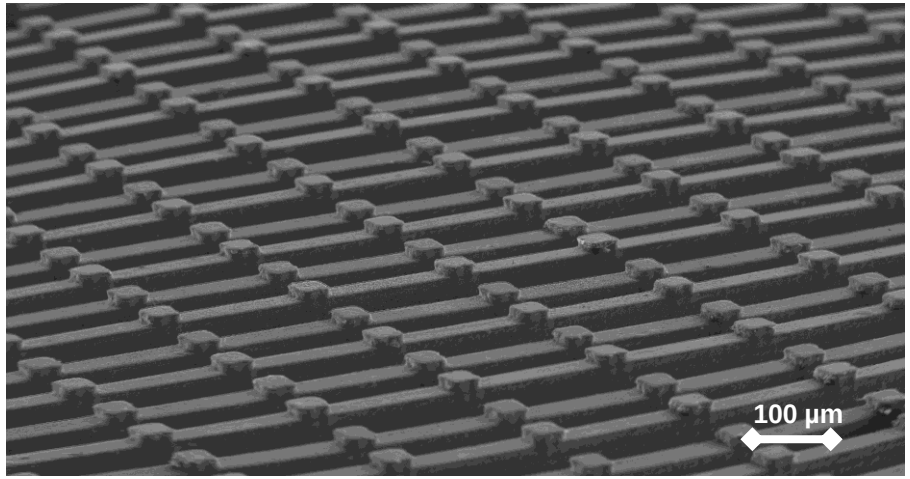
Zusatzinformation / Further Info.

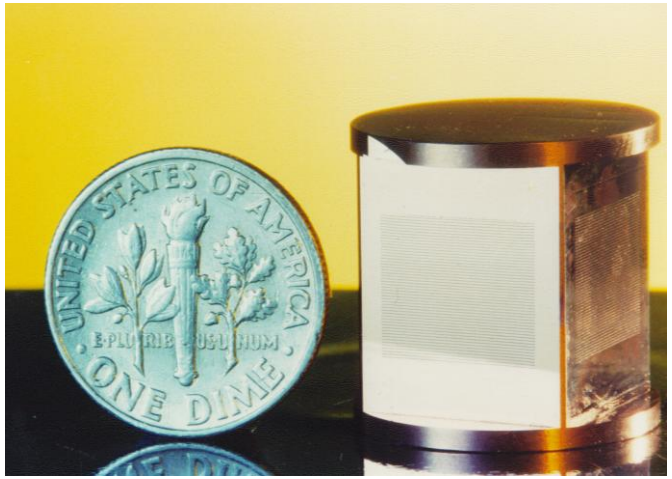
Die Vorlesung gibt einen Überblick über Miniaturisierung, Prozessintensivierung und die Anwendung dieser Technologie für Wärmeübertrager.
The lecture provides an overview to miniaturization, process intensification and the application of these technologies for heat transfer systems.











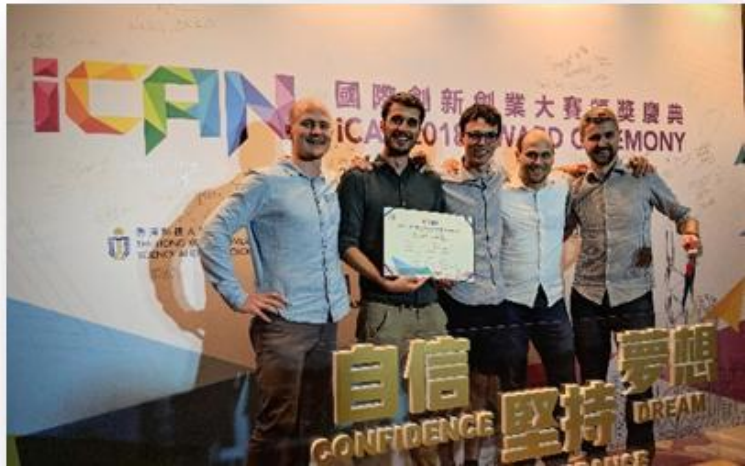
Mikrosystemproduktenwicklung für junge Unternehmer

Deinen Produkt ➡ Deine Firma

- Angewandtes Lernen
- Selbstverwirklichung
- Fachwissenvermittlung in:
  - (Mikro-)systemtechnik
  - Eingebettete Elektronik
  - Rapid Prototyping
  - Start-up Konzepte

Beschreibung

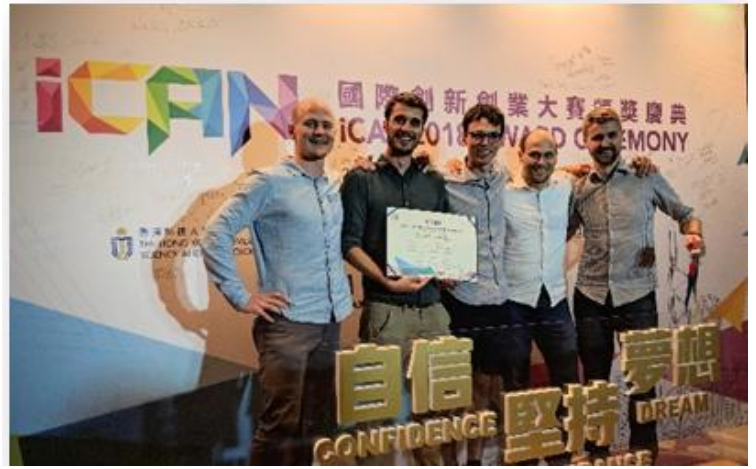
Du und Dein Team entwickelt aus Euren Ideen einen Prototyp, der nicht nur ein technisches Problem löst, sondern auch das Potential zu einem erfolgreichen Produkt hat. Aus dem Kurs sind z.B. der StraightUp Haltungstrainer und der Heat-it Stichheiler entstanden.
Was wird Dein Produkt können?



Microsystem Product Design for Young Entrepreneurs

Your Product ➡ Your Company

- applied learning
- self-fulfilment
- expertise will be gained in:
  - (micro-)system technology
  - embedded systems
  - rapid prototyping
  - start-up concepts



Further Info

You and your team will develop your ideas into a prototype that will not only solves a technical problem but also has the potential to become a successful product. The course has i.e. sparked the StraightUp posture trainer and the Heat-it stitch healer.

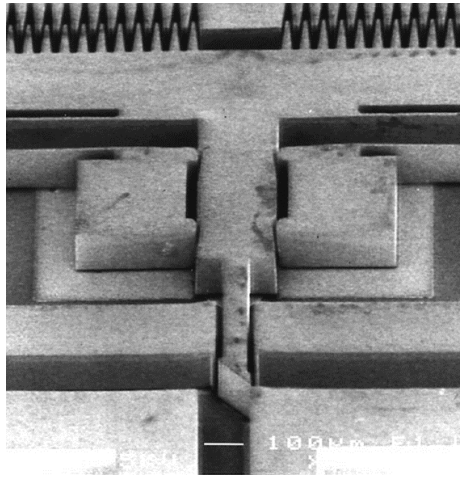
What will your product be capable of?

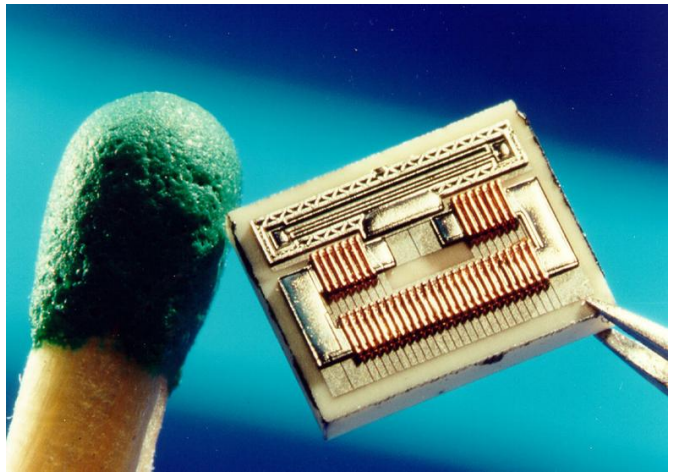
Mikroaktorik / Microactuators

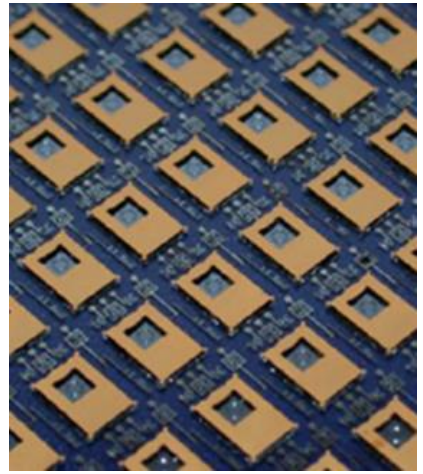
Übersicht

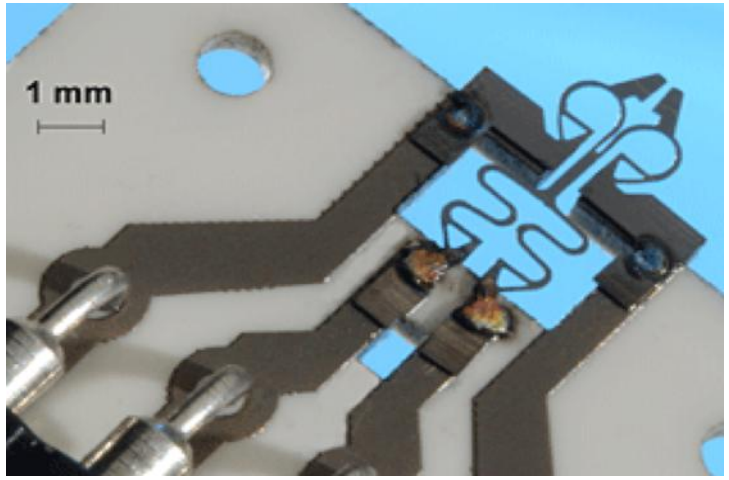
- Aktorprinzipien / Wandlermaterialien
- Mikroelektromechanische Systeme: Linearaktoren, Mikrorelais, Mikromotoren
- Medizintechnik und Life Sciences: Mikroventile, Mikropumpen, mikrofluidische Systeme
- Mikrorobotik: Mikrogreifer, Polymeraktoren (smart muscle)
- Informationstechnik: Optische Wellenleiteraktoren, Spiegelaktoren, Schreib-/ Leseköpfe

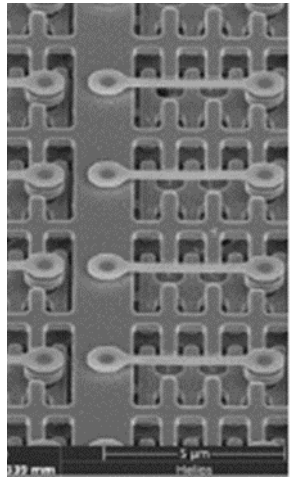
Link:
https://www.imt.kit.edu/3968_4058.php

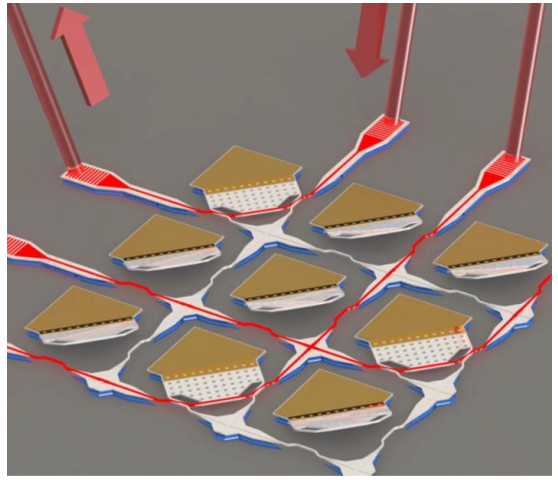










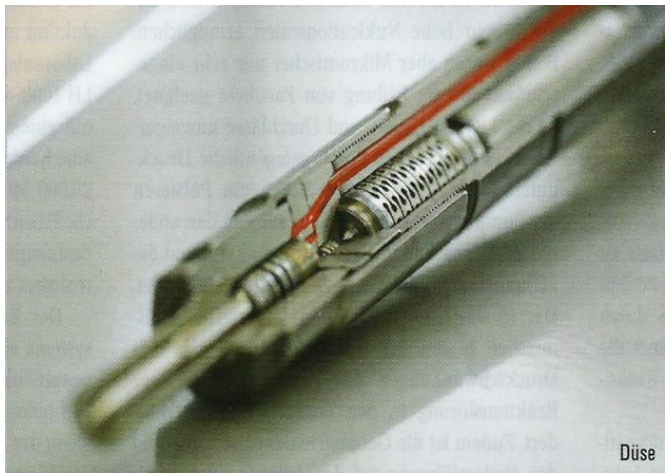


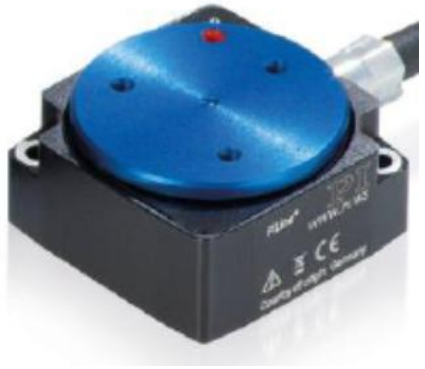
Neue Aktoren und Sensoren / Novel Actuators and Sensors

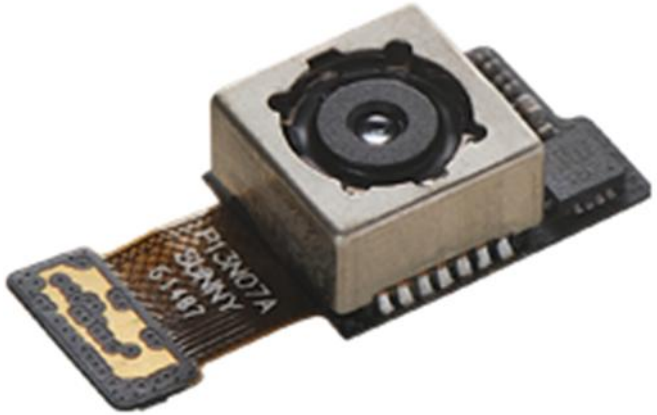
Übersicht

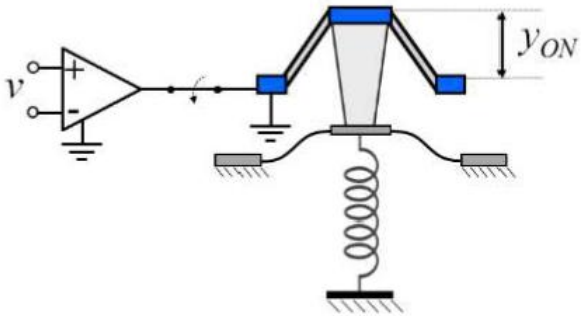
- Aktor- und Sensor-Materialien
- Piezoaktoren: Stapelaktoren, Biegeaktoren, Ultraschallwandler, Nanopositionierung
- Magnetostriktive Aktoren: Schrittmotoren, Wanderwellenmotoren
- Formgedächtnisaktoren: Ventilsysteme, haptische Systeme
- Elektro-/Magnetorheologische Aktoren
- Inertial-Sensoren
- Druck-Sensoren
- Durchfluss-Sensoren / Gas-Sensoren
- Magnetfeld-Sensoren
- Quantenbasierte Sensoren

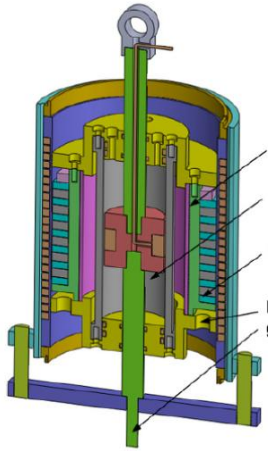
Link: https://www.imt.kit.edu/3968_4386.php











Praktikum Mikrosystemtechnik

Versuche zu den Themen

- UV-Lithographie
- Fluidische Komponenten aus Polymerwerkstoffen
- Rasterkraftmikroskopie
- 3D-Printing
- Heißprägen von Kunststoff-Mikrostrukturen
- Grundlagen der SAW-Biosensorik
- Elektrospinning Technologie für 3D Fertigung
- Röntgenoptik
- Kernspintomographie
- Zwei-Photonen Lithographie

Correl-Labor mit Röntgenquelle und Kernspintomograph; KIT/

Organisatorisches

- Max. ~30 Teilnehmer (Gruppen mit 3-5 Personen)
- Vier Versuche in einer Woche, halbtags
- Woche nach Aschermittwoch; 2. ganze Septemberwoche
- Schriftliche Klausur in der Folgewoche

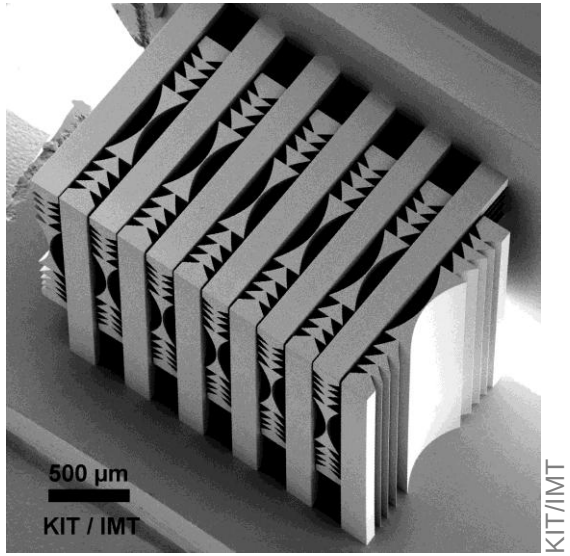
Lecture „X-ray optics“

Content

- X-ray sources
- Propagation of X-rays in matter
- Principles of optics and imaging
- Types of X-ray optics: reflecting, refracting, diffracting, absorbing
- Characteristics / characterization of X-ray optics
- Methods to simulate X-ray optics (ray tracing, wave propagation)
- Manufacturing of X-ray optics
- X-ray detection
- Applications: Medical, material sciences…
- X-ray analytical methods

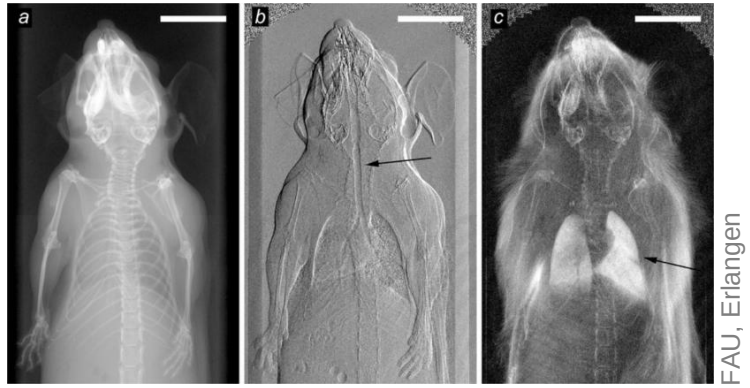
Organisational

- Block lecture in March/April and July
- Date in consultation with the students



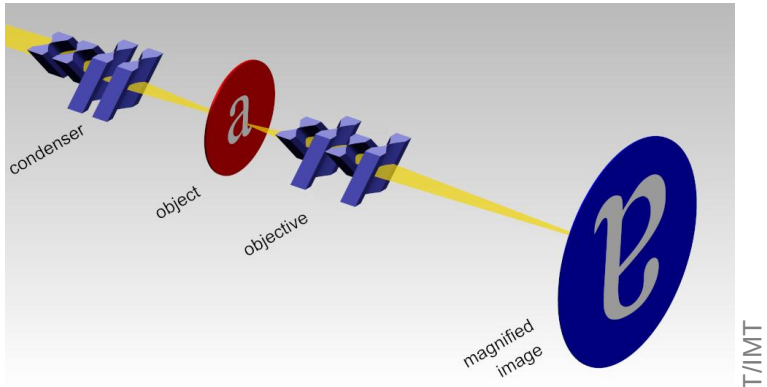
KIT/IMT

X-ray lens



FAU, Erlangen

Phase contrast image of a mouse



KIT/IMT

X-ray microscope

KIT/KARA

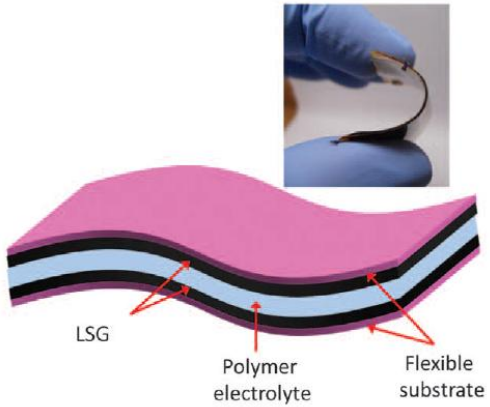
Bug CT

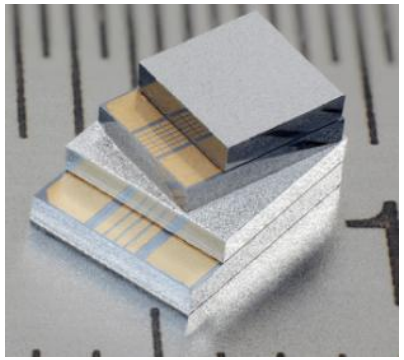
Micro Energy Technologies

Energy conversion and storage for the next generation of microsystems

Energy Harvesting Technologies

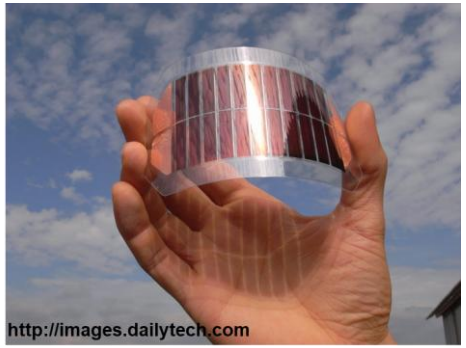
- Kinetic energy harvesting
- Micro thermoelectrics
- Micro thermomagnetic energy generation
- EM field energy conversion
- Microsystem-enabled photovoltaics

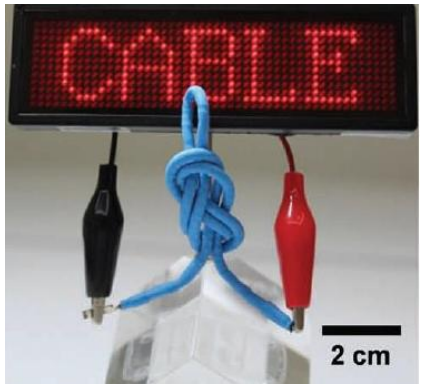




Energy Storage & Cooling

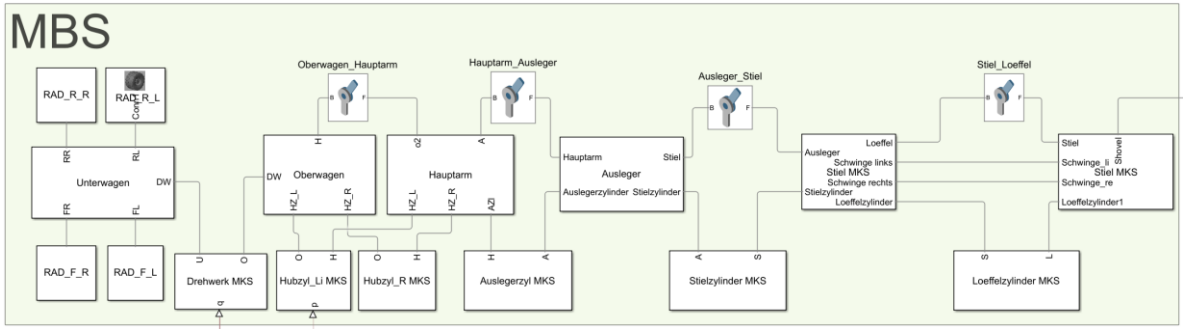
- Micro batteries and supercapacitors
- Micro fuel cells
- Solid-state cooling technologies

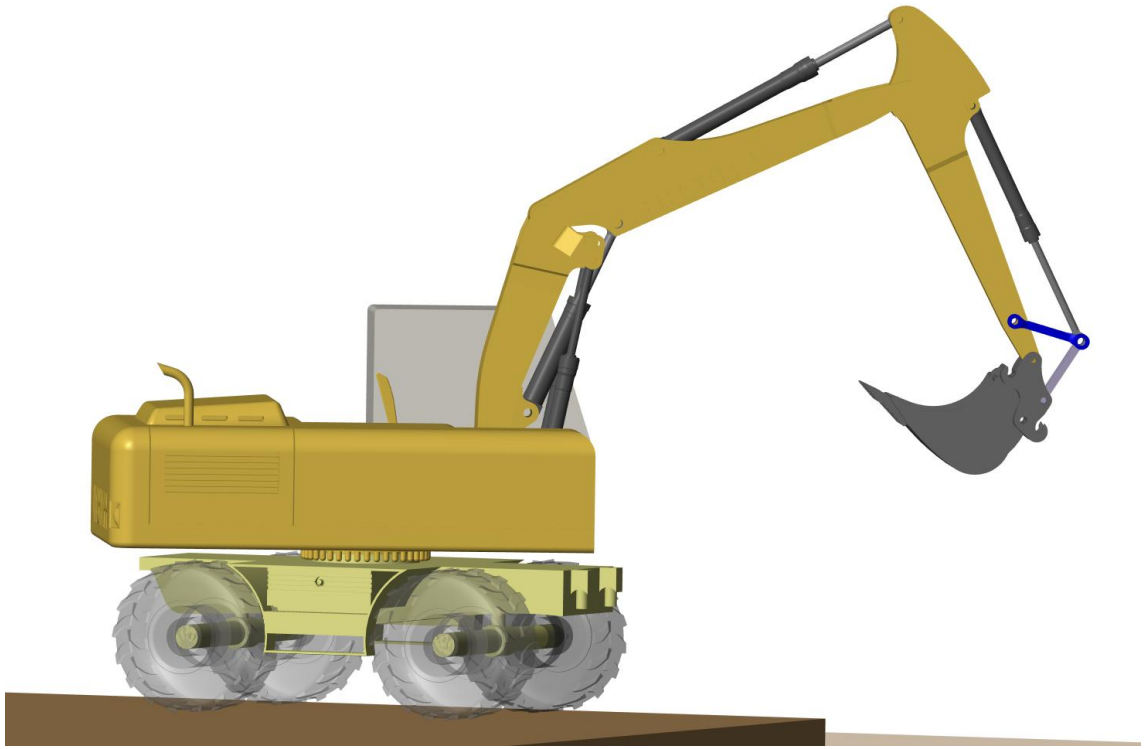




Simulation mit konzentrierten Parametern

- Theoretische Grundlagen zu Netzwerken und Analogien
- Simulation von Mehrkörpersystem:
  - Mechanisch
  - Hydraulisch
- Regelung
- Co-Simulation ggf. Validierung





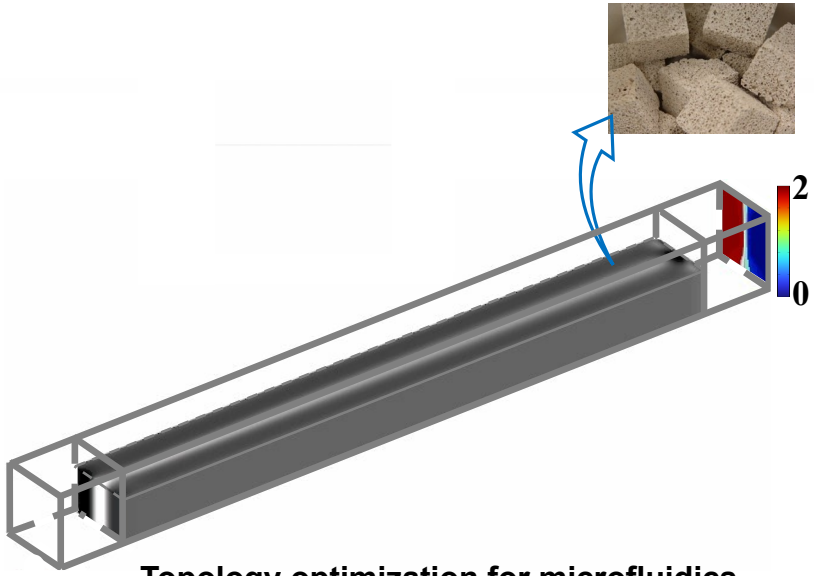
Topology Optimization in Engineering

Übersicht / Overview

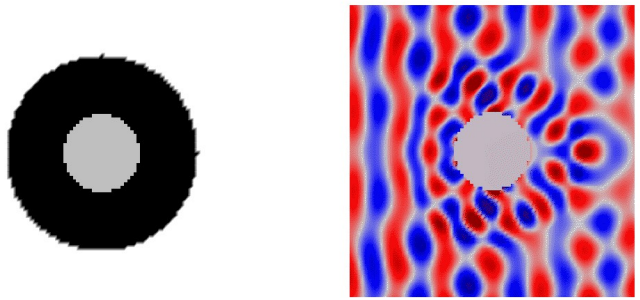
- Topology optimization
- Partial differential equations
- Finite element method
- Adjoint analysis
- Material distribution method
- Level set method

Zusatzinformation / Further Info.

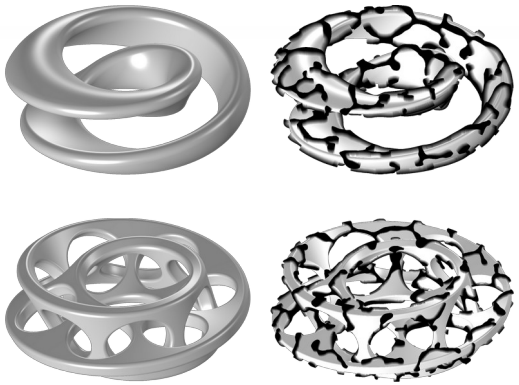
This lecture familiarizes the students with the basic knowledge of topology optimization which is one of the current most powerful structural design methods. The related implementing details and numerical skills of topology optimization will also be provided.



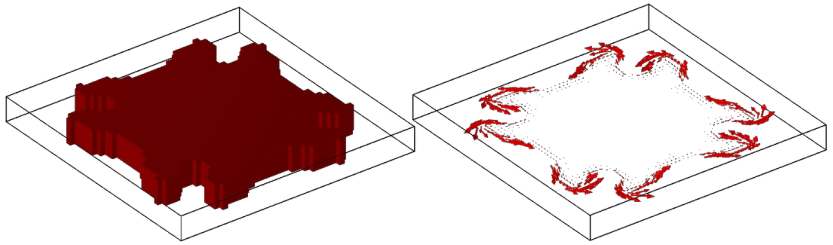
Topology optimization for microfluidics



Topology optimization for nano-optics



Topology optimization on 2-manifolds



Topology optimization for superconductivity

Mechanical Properties of Nanomaterials and Microsystems
T-MACH-114018

IAM
Institut für Angewandte Materialien

Overview

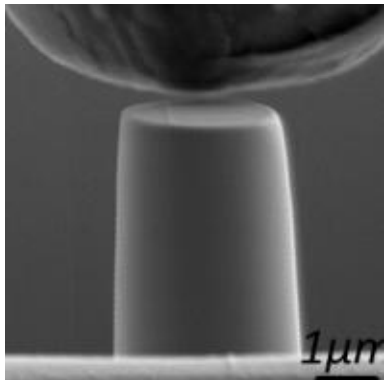
- Scaling and size effects
- Microplasticity
- Microfracture
- Thin films
- Dislocation dynamics simulation
- Sensors and actuators

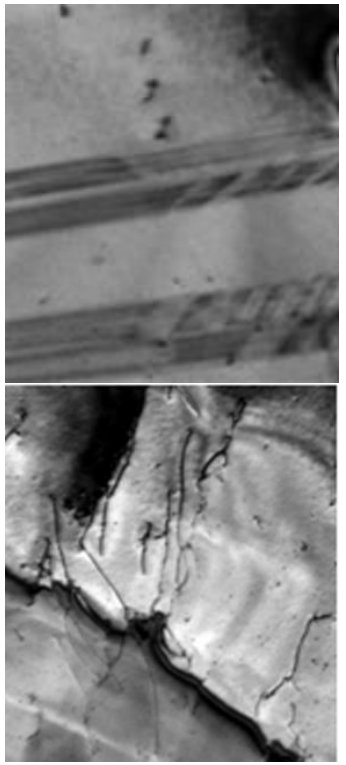
Further Information

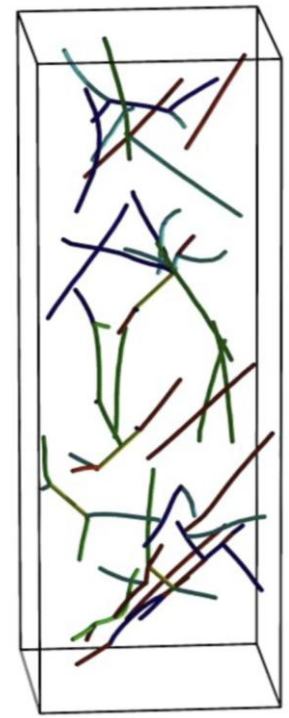
Summer term, Wednesday, 08:00-09:30
Building 10.91, Oberer Hörsaal
2SWS / 4LP, oral exam
Course 2178420
German lecture in winter term

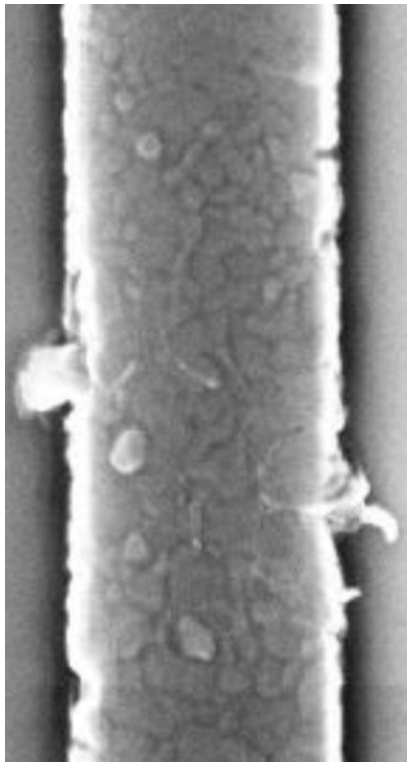
Dozenten:
C. Kirchlechner, P. Gruber, D. Weygand,
C. Greiner (IAM-MMI und IAM-ZM)

Mechanistic understanding of small scale mechanics and failure









Testing | **Imaging** | **Modelling** | **Applying**

KIT

Mechanische Eigenschaften von Nanomaterialien und Mikrosystemen T-MACH-114071

Übersicht

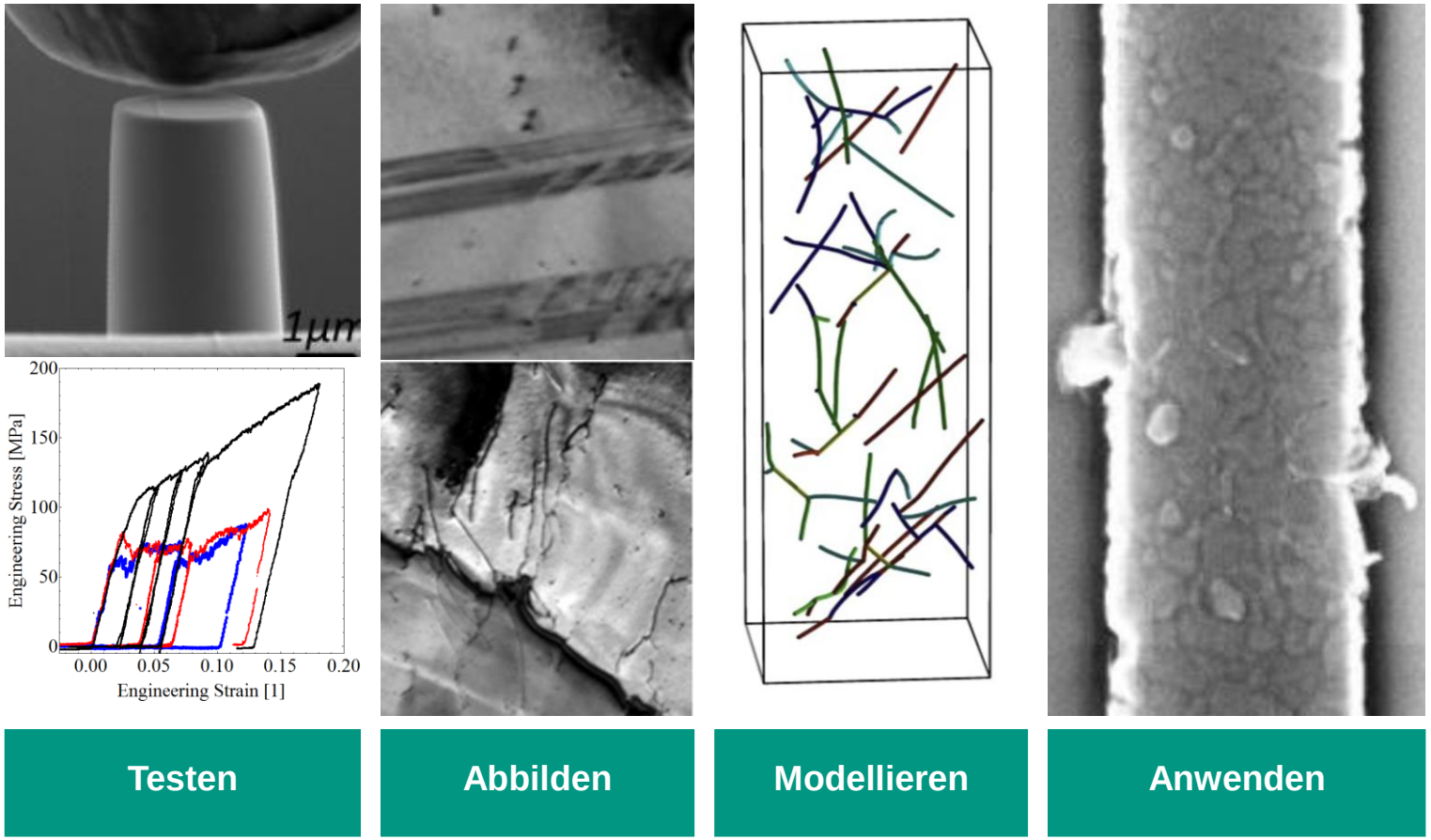
- Skalierungs- und Größeneffekte
- Mikroplastizität
- Mikrobruch
- Dünne Schichten
- Versetzungsdynamiksimulation
- Aktoren und Sensoren

Zusatzinformation

Wintersemester, Donnerstag, 09:45-11:15
Geb. 10.91, Oberer Hörsaal
2SWS / 4LP, mündliche Prüfung
LV 2177013
Englische Vorlesung im Sommersemester

Dozenten:
C. Kirchlechner, P. Gruber, D. Weygand,
C. Greiner (IAM-MMI und IAM-ZM)

Mechanistisches Verständnis von Mikromechanik und Schädigung

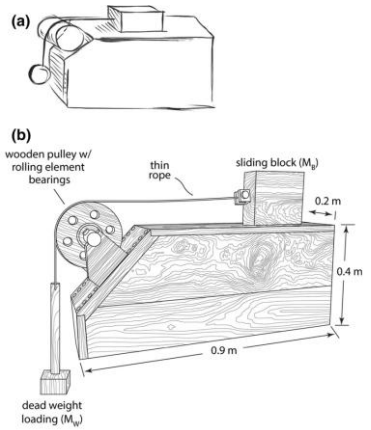


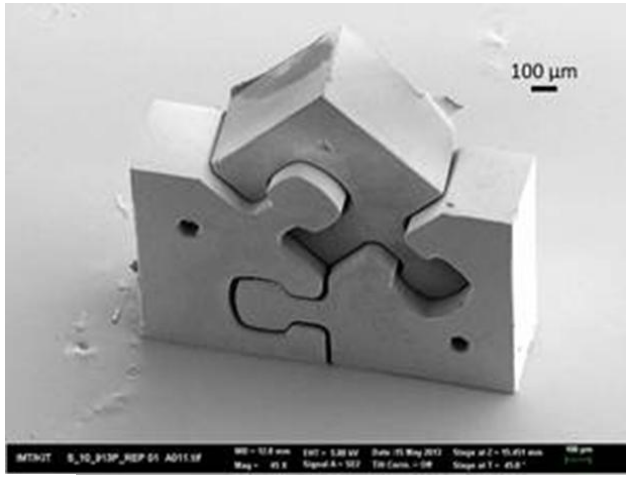
Testen | **Abbilden** | **Modellieren** | **Anwenden**

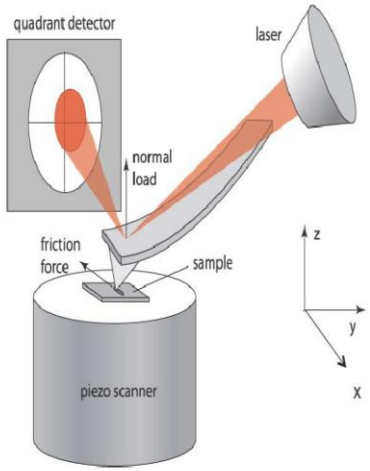
Kontaktmechanik

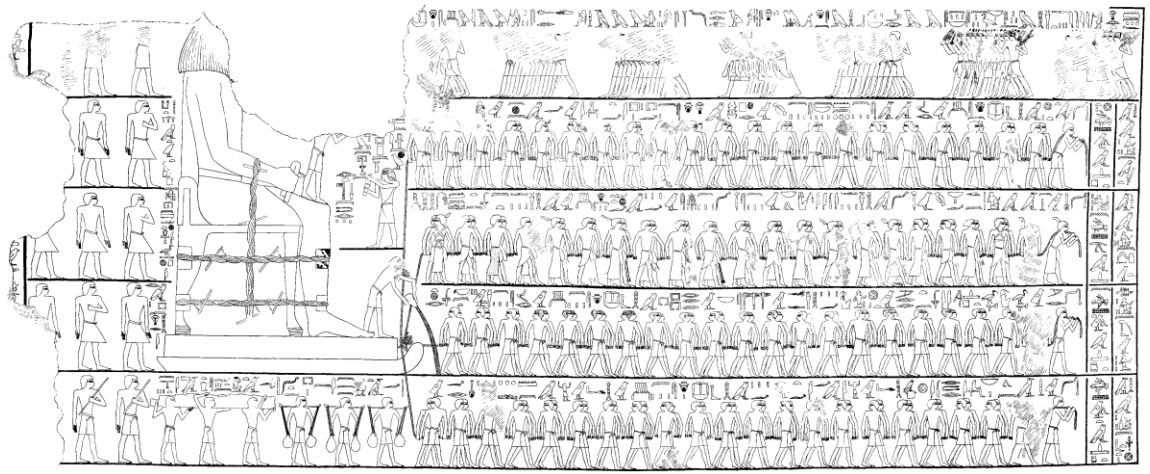
Übersicht

- Bedeutung von Kontakten
- Hertz‘sche Kontaktmechanik
- Adhäsive Kontakte
- Fibrilläre Adhäsive; Gecko-Tape
- Raue Oberflächen
- Experimentelle Methoden









Zusatzinformation / Further Info.

In der Vorlesung geht es uns darum zu verstehen warum mechanische Kontakte zwar in de facto jedem technischen System auftreten, sie aber dennoch oft vernachlässigt werden. Warum rechnen wir bis heute mit einer Lösung aus dem Jahr 1881 und wie sehen modernere Alternativen aus?

Polymers in MEMS A – C

Overview

- **Polymers in MEMS A**: *Chemistry, Synthesis and Applications*
- **Polymers in MEMS B**: Physics, *Microstructuring and Applications*
- **Polymers in MEMS C** - *Biopolymers and Bioplastics*

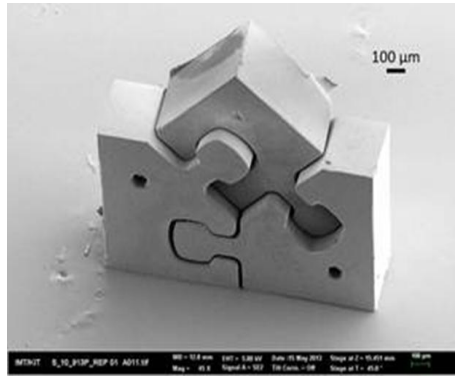
Further Info.

- 3 independent modules
- In presence and online
- Teaching language: English

Polymer synthesis
Polymerization steps
Characterization
Photoiithography

Polyurethane synthesis

Physics of polymers
Polymer materials
Modeling of viscoelasticity
Polymer processing
Micro replication technology



Micro injection molding

Bioplastics
Degradability
Microplastic
Sustainability
Resources
DNA, Peptides

Degradation of a (bio)plastic bottle