UPPSALA UNIVERSITET

Welcome to Uppsala University

The Ångström Laboratory

Transnational Access to Major Research Infrastructures

Access to Research Infrastructures

Ångström Nano Centre

http://www.angstrom.uu.se/nanocentre/

The Ångström Laboratory at Uppsala University has been selected by the European Comission, in the 5th framework program, as a site to provide **Transnational Access to Major Research Infrastructures (Contract number: HPRI -CT-2002-00192)**

Some facts on Uppsala and Uppsala University

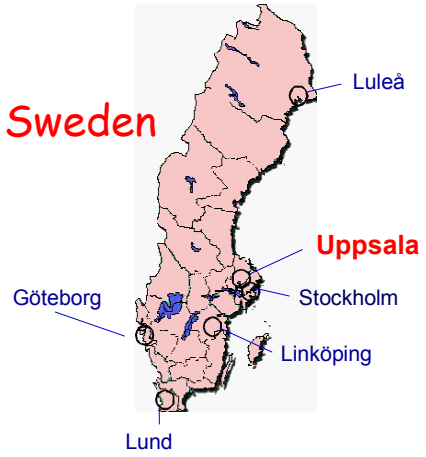
Number of inhabitants:	180.000
Fastest growing city in Sweden	(no 4 in size)
Distance to Arlanda:	30 km

The three major working places:

The Academic hospital	6.000
Uppsala university	5.500
Pharmacia & Upjohn	5.000

More on Uppsala University

No of professors:	300
No of lecturers/scientists	1.600
No of PhD students	1.100
Total:	3.000
Total number of students	30.000



Microsystems

- Micro (dimension)
- Electro (electronics and/or electricity)
- Mechanical (moving parts)
- Systems (combination of several types of components)

Systems issues *must* be confronted:

- packaging
- system partitioning into components
- calibration
- signal-to-noise ratio
- stability, and reliability

micro-

- electronics
- mechanics
- optics
- fluidics

Microsystems at Uppsala University

The Ångström Laboratory

- Started 1983
- MST based on new materials and fabrication techniques
- MST in spacecraft technology
- Optical MEMS
- Piezoelectric and paraffin-driven microactuators
- MST in microwave front-end integration
- 28 dissertations in MST until today *(KH has part in 12)*
- 36 person-years research effort year 2003
- Largest microengineering clean-room in northern Europe - 2000 sqm opened 1997

Advanced Microengineering at The Ångström Laboratory

Klas Hjort

Director of SUMMIT

AME
Centre for Advanced Microengineering

summit
SURFACE & MICROSTRUCTURE TECHNOLOGY

The Ångström Space Technology Centre

The Ångström Laboratory

http://www.angstrom.uu.se/materials/

Some facts

45.000 m²

700 employees

including 290 PhD students

2.400 under graduate students

30 km from Arlanda airport

Hosts the following departments:

Materials Science (# 250)

Materials Chemistry

Physics

Radiation Science

Astronomy and Space Physics

Neutron Research

Divisions at

Department of Materials Science

Materials Science

Tribomaterials

Micro System Technology

The Ångström Space Technology

Solid State Physics

Solid State Electronics

Space Technology Centre

Solid Mechanics

Analytical Materials Science

Electricity and Lightning Research

What is SUMMIT?

- The Center for Surface and Microstructure Technology - SUMMIT - an industry-relevant competence center financed equally by VINNOVA, industry and academia.
- SUMMIT is located at Uppsala University and is headed by Assoc. Prof. Klas Hjort.
- Groups from The Royal Institute of Technology (KTH) and ACREO AB are closely affiliated.
- Approximately 25 researchers at 9 manyears/year engagement – industry meet up with approximately 4 manyears/year, in total.

summit

SURFACE & MICROSTRUCTURE TECHNOLOGY

Companies

- Biacore
- Biosensor Applications
- Ericsson Radio Systems
- Instrumentarium / Datex-Ohmeda
- Radi Medical Systems
- Saab Ericsson Space
- SenseAir
- Spectrogon
- ÅMIC

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SURFACE & NANOSTRUCTURE TECHNOLOGY

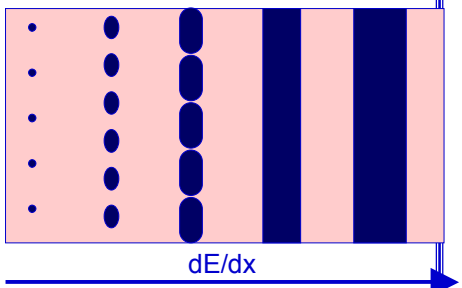
The Ion Track Lithography Team

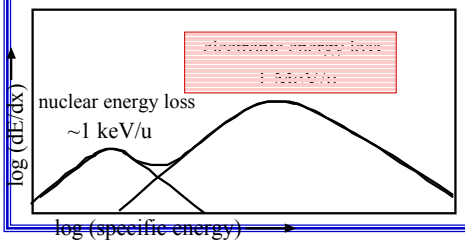
The team is composed by 7 researchers:

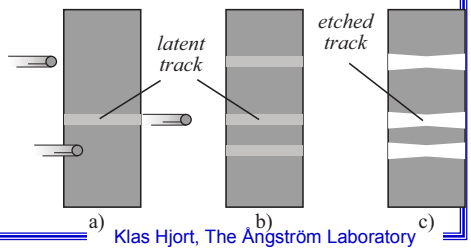
- K. Hjort
- M. Abid, M. Lindeberg, H. Majjad: Postdocs
- M. Lehto, M. Skupinski, H. Yousef: PhD students
- … and often M.Sc. students

Ion track lithography

- Ion track technology was developed in the 70's. It is today used for low-cost sub-micron filtration (10 US$/sqm)
- It enables low-density columnar tracks of the highest aspect ratio, but in a stochastic pattern.
- Ion track lithography is a novel approach combining micron resolution patterning with the nanosized columnar tracks.

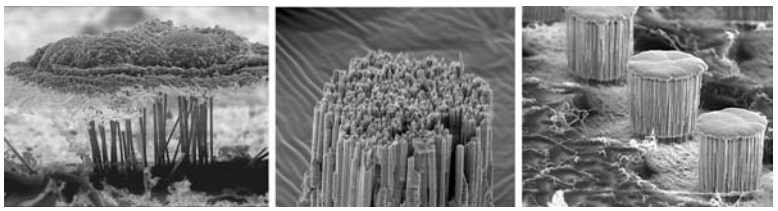






Ion track enabling of PCB

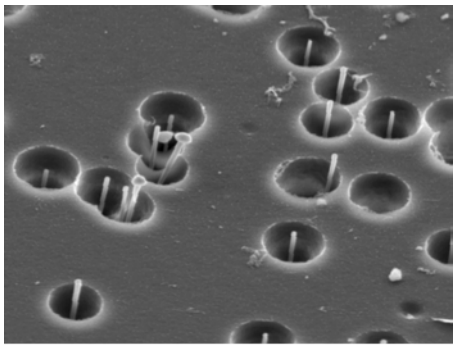
- Low ion track density laminates enable small cross sections of via connectors although PCB lithography have low resolution: enable several types of sensors

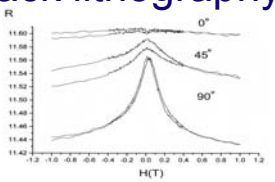


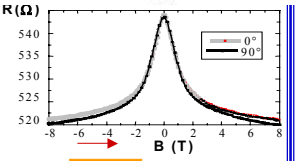
- High ion track density laminates enable interlaced nanowire bundles for PCBs with ultra-high density of through-contacts and low-loss microwave circuits

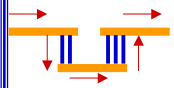
Magnetic sensors using ion track lithography

AMR and GMR





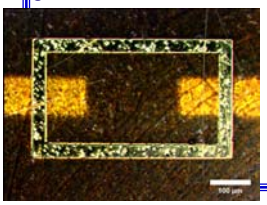


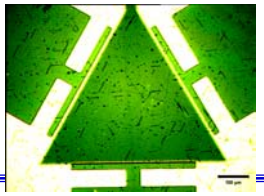


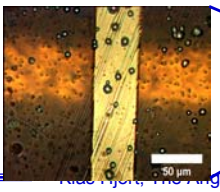
Single-side contacted MR-sensor

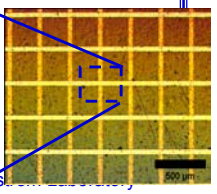
3D AMR

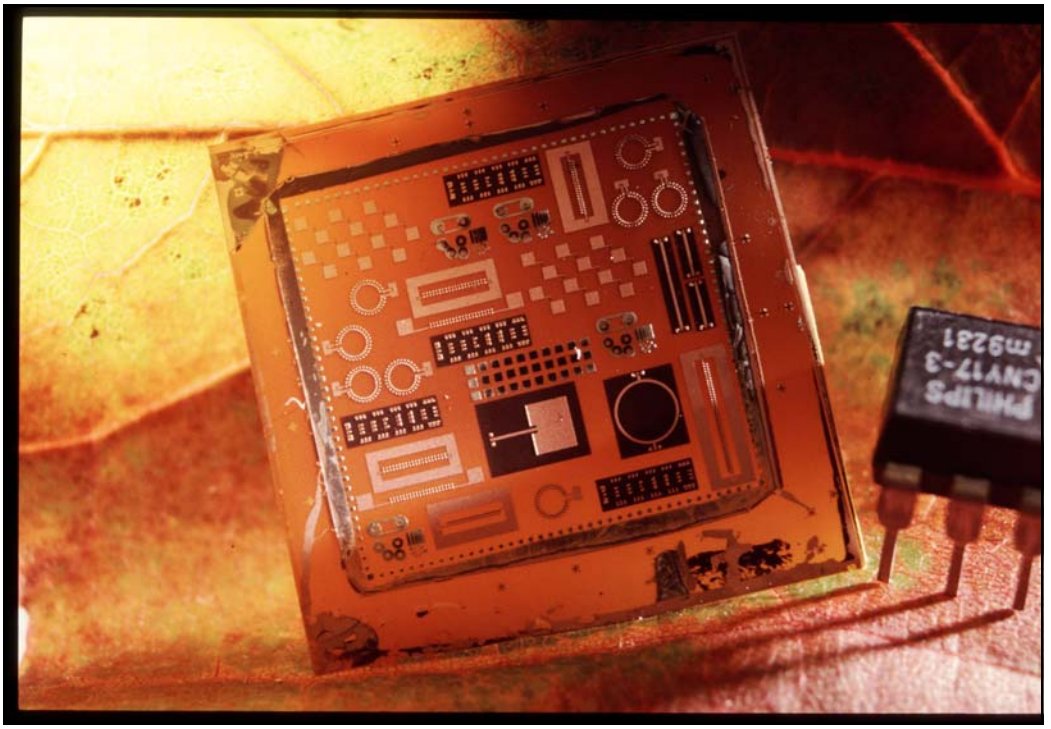
Double-side contacted MR-sensors











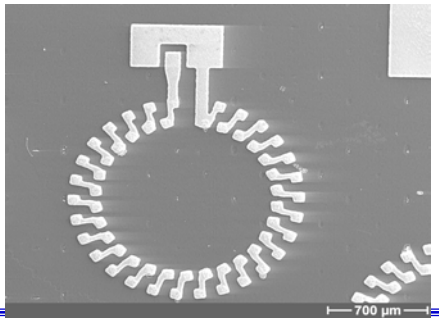
Inductive Coils by Ion Track Lithography

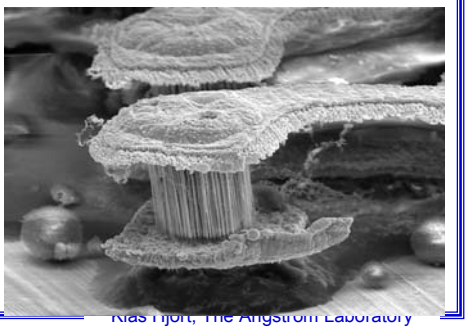
Toroids *integrated* in Kapton flexcards:

Inductance of 4.8 nH

Low-cost high-aspect-ratio vias

Q-values of 17 at 2.45 GHz



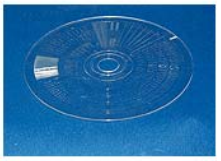


… and more?

Combining CD- and PCB technologies with ion track lithography we hope to make low-cost microsystems for biomedical applications

Micromachiningtechniques

CD-technology

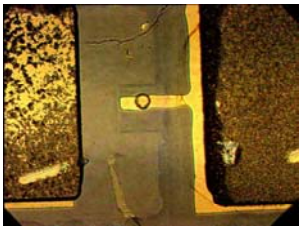


Replication of 3D-microstructures

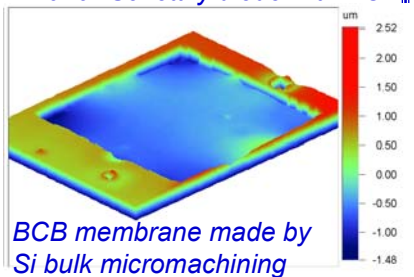
Replication technology - basics

InP Schottky diode on microwave waveguide in BCB on Si

- Capability of obtaining a hybrid circuit by using planar thin film technology, integrating III-V electronic devices with a BCB membrane on silicon.
- Epilayer devices that can be patterned by classical photolithographic methods.
- The smallest Schottky contact obtained has a diameter of 3 μm, enough for operation at frequencies higher than 50 GHz.
- The Schottky diode height is less than 2 μm.



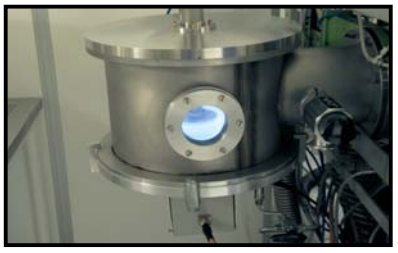
Planar Schottky diode with BCB

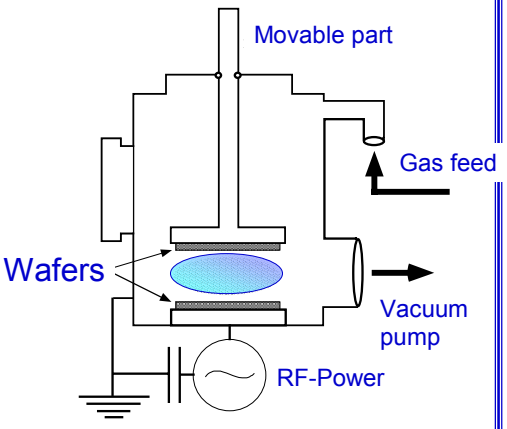


BCB membrane made by Si bulk micromachining

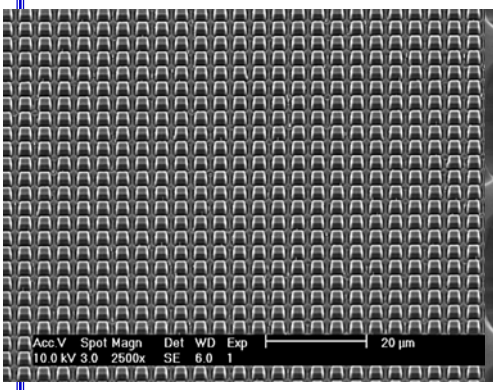
Plasma activated bonding

Oxygen plasma activated *in situ* InP-to-Si bonding.

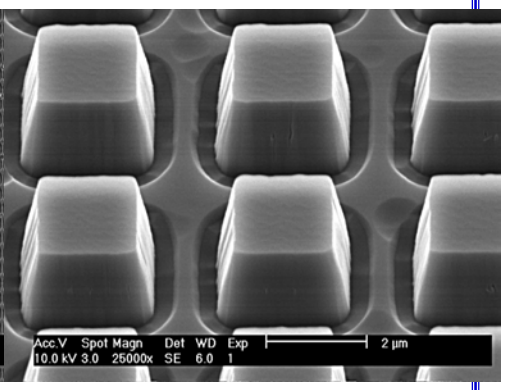




Fabrication of antireflection subwavelength grating

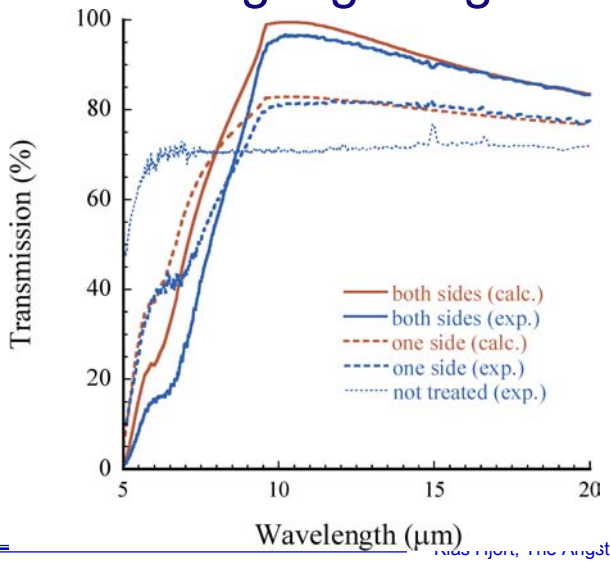


SEM picture of a subwavelength grating in diamond



Close-up picture of the subwavelength grating.

Resulting antireflection subwavelength grating



Acknowledgements

Industrial collaborations

- Biacore
- Biosensor Applications
- Ericsson
- ABB Hafo
- Saab Ericsson Space
- Spectrogon
- Gyros
- Åmic
- LOAB / Obducat
- Amersheim Biosciences
- Pharmacia Diagnostics
- Instrumentarium
- Outocompu Semiconductors
- SenseAir

International

- Microsensor Kiev
- Thompson CSF / Thales, Paris
- Pantechnik, Caen, F
- Microcrystal, Grenchen, Ch

Swedish collaborations

- Linköping University
- Royal Inst. Technol.
- Chalmers
- ACREO
- Lund University
- Uppsala University
  - Biochemistry
  - Analytical Chemistry
  - Solid State Physics
  - Solid State Electronics
  - Microwave Electronics
  - Ion Physics
  - The Svedberg Lab.

International collaborations

- TU Darmstadt
- GSI Darmstadt
- IMM, Mainz
- HMI Berlin
- Ecole Central de Lyon
- CIRIL
- GANIL
- INSA de Lyon
- ENS Cachan
- LPMO Becanson
- HAS Budapest
- Fort Heraklion
- Tor Vergata Roma
- IRST Trento
- ITME Bucharest
- IMST Warsaw
- UC Berkeley
- Argonne Nat. Lab.