



dcn

dresden center for
nanoanalysis

DRESDEN CENTER FOR NANOANALYSIS

Ehrenfried Zschech

Scientific Coordinator

Dresden, February 2014

www.tu-dresden.de/dcn



DCN - WORKING GROUP AT TU DRESDEN



► Scientific Coordinator

Ehrenfried Zschech, Fraunhofer/DFCNA & TU Dresden/DCN

► Administration Manager

Linda Kriusk, TU Dresden/DCN

Team members (representatives of the active contributing faculties at TU Dresden)

- Johann Bartha TU Dresden/Faculty of Electrical and Computer Engineering
- Christoph Leyens TU Dresden/Faculty of Mechanical Science and Engineering
- Lukas Eng TU Dresden/Faculty of Science, Department of Physics
- Michael Mertig TU Dresden/Faculty of Science, Department of Chemistry
- Viktor Mechtcherine TU Dresden/Faculty of Civil Engineering, Institute of Construction Materials

DCN WORKING GROUP AT TU DRESDEN



Permanent guests

- ▶ Gerhard Rödel TU Dresden/Vice-Rector for Research
- ▶ Hannes Lehmann TU Dresden/Research Promotion and Transfer
- ▶ Gerhard Fettweis TU Dresden/Coordinator & Scientific Director cfaed
- ▶ Wolfgang Nagel TU Dresden/Center for Information Services and High Performance Computing (ZIH)

Representatives of non-university institutes (DRESDEN concept)

- ▶ Juri Grin Max Planck Institute for Chemical Physics of Solids (CPFS), Dresden
- ▶ Bernd Rellinghaus Leibniz Institute for Solid State and Materials Research Dresden (IFW)
- ▶ Manfred Stamm Institute of Physical Chemistry & Physics of Polymers (IPF), Dresden
- ▶ Rene Hübner Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Dresden
- ▶ Andreas Leson Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS Dresden

DCN PARTNER



- ▶ **Barbara Adolphi, Johann Bartha**
(TU Dresden/Faculty of Electrical and Computer Engineering)
- ▶ **Lukas Eng, Alexander Haußmann, Peter Milde**
(TU Dresden/Faculty of Science, Department of Physics)
- ▶ **Martin Gall, Uwe Mühle, Ehrenfried Zschech**
(Fraunhofer IKTS)
- ▶ **Christoph Leyens, Hans Peter Wiesmann**
(TU Dresden/Faculty of Mechanical Science and Engineering)
- ▶ **Viktor Mechtcherine, Christof Schröfl**
(TU Dresden/Faculty of Civil Engineering, Institute of Construction Materials)
- ▶ **Michael Mertig, Thomas Doert**
(TU Dresden/Faculty of Science, Department of Chemistry)
- ▶ **Ellen Hieckmann** (TU Dresden/ Institute for Applied Physics/Semiconductor Physics)
- ▶ **Peter Zahn** (TU Chemnitz/Faculty of Science, Department of Physics)

NANOANALYTIK-NETZWERK IN DRESDEN

Nanoanalytik: TU Dresden DCN und Fraunhofer DFCNA

Zwei Analytik-Zentren in Dresden:



Dresden Center for Nanoanalysis (DCN)

Dresden Fraunhofer Cluster Nanoanalysis (DFCNA)

Rahmen: DRESDEN concept

DCN – VISION & MISSION



Vision

- ▶ International visible center of competence in the field of 4D materials analysis („4D AMASE“) and European user center

Mission

- ▶ Scientific excellence: Leading-edge research
- ▶ Advanced Materials Analysis for Science and Engineering“
- ▶ Service center: Partner for science and engineering schools
- ▶ Education at internationally highest level

CORE TOOLSET (PLAN)

Electron and ion microscopy

- ▶ TEM: Tomography, Holography, Low-voltage TEM
- ▶ SEM: „Workhorse“ SEM/EDX, Next-generation SEM
- ▶ SEM-FIB: incl. manipulators
- ▶ 3D Atom Probe

X-ray microscopy

- ▶ TXM: sub-micron XCT, micro XCT

Scanning probe microscopy

- ▶ SPM: high time resolution
- ▶ SPM: high spatial resolution

FIRST TOOLS IN CENTRAL DCN LAB



Campus TU Dresden / Barkhausenbau

SEM (scanning electron microscope) / FIB (focused ion beam)

- ▶ FEI Helios NanoLab 650

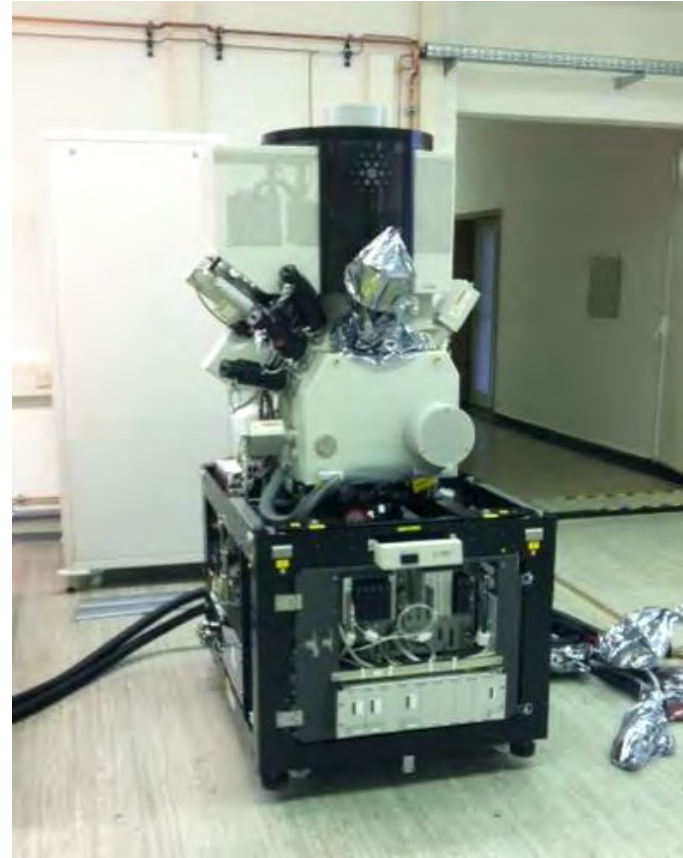
XRM (X-ray microscope)

- ▶ Zeiss/Xradia XR-VersaXRM-520

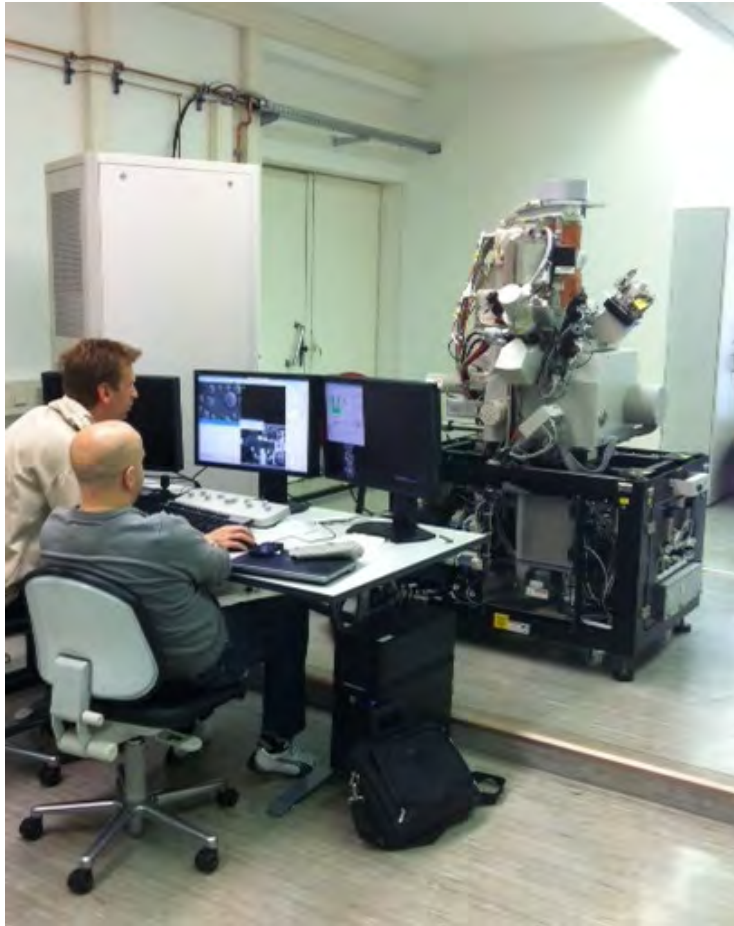
SPM (scanning probe microscope) ... 2Q 2014

28 OCTOBER 2013

First TU Dresden/DCN tool move-in: FEI Helios Nanolab 660



DCN-LAB WITH SEM/FIB AND SUB-MICRON XCT



Dresden Center for **Nanoanalysis**

FEI: HELIOS NANOLAB 660

Standort: DCN Labor - Barkhausenbau 168

- ▶ Tomahawk ion column, down to 500V and up to 65nA, 2.5nm resolution at 30kV
- ▶ sub-nm e-beam resolution from 1kV to 30kV, 1.5nm at 200V
- ▶ Multiple GIS for flexibility: Au, Pt, W for deposition and I2 and XeF2 for etching
- ▶ Manipulator system for precise lift-out
- ▶ Multiple detectors for ion and electron mode, including ICE for SI and SE



DECENTRAL TOOLS



CORE TOOLSET (JANUARY 2014)

Tool	Manufacturer	Specific name / Type	Contact
high-resolution scanning electron microscope (SEM)	HITACHI	S4700	Dr. Barbara Adolphi / TU Dresden
high-resolution scanning electron microscope (SEM)	HITACHI	SU8020	Prof. Dr. Thomas Doert / TU Dresden
atomic force acoustic microscope (AFAM)	Digital Instrument	Dimension 3000	Dr. Malgorzata Kopycinska-Müller / Fraunhofer IKTS-MD
atomic force acoustic microscope (AFAM)	Agilent	5600 LS	Dr. Malgorzata Kopycinska-Müller / Fraunhofer IKTS-MD
Nanoindenter	Hysitron	TI 950	Dr. Martin Gall / Fraunhofer IKTS-MD
scanning electron microscope (SEM) / focused ion beam (FIB)	Zeiss	NVision 40	Dr. Rüdiger Rosenkranz / Fraunhofer IKTS-MD
transmission electron microscope (TEM)	Zeiss	Libra 200 HR MC Cs STEM	Dr. Uwe Mühle / Fraunhofer IKTS-MD
X-ray microscope (XRM)	Xradia	NanoXCT-100	Dr. Uwe Mühle / Fraunhofer IKTS-MD
scanning electron microscope (SEM)	Philipps/FEI	ESEM XL 30 (with EDX)	Prof. Dr. Hans-Peter Wiesmann / TU Dresden
scanning electron microscope (SEM)	Philipps/FEI	ESEM XL 30	Prof. Dr. Viktor Mechtcherine / TU Dresden
scanning electron microscope (SEM)	Zeiss	DSM 950 (with EDX)	Prof. Dr. Hans-Peter Wiesmann / TU Dresden
scanning electron microscope (SEM)	Zeiss	DSM 982	Prof. Dr. Hans-Peter Wiesmann / TU Dresden
computer tomograph	Scano Medical	vivaCT 75	Prof. Dr. Hans-Peter Wiesmann / TU Dresden
low-temperature atomic force microscope (AFM)	Omicron	LT-SPM	Dr. Peter Milde / IAPP Dresden
room-temperature atomic force microscope (AFM)	Cypher	RT-SPM	Dr. Alexander Haußmann / IAPP Dresden
room-temperature atomic force microscope (AFM)	AIST-NT	SMART-SPM	Dr. Alexander Haußmann / IAPP Dresden
single-crystal X-ray diffractometer (SC-XRD)	STOE	IPDS-II	Prof. Dr. Thomas Doert / TU Dresden
single-crystal X-ray diffractometer (SC-XRD)	Bruker-AXS	APEX II	Prof. Dr. Thomas Doert / TU Dresden
X-ray powder diffraction (XRPD)	PANalytical	XPert Pro	Prof. Dr. Thomas Doert / TU Dresden
Confocal Raman, Rayleigh, and photoluminescence spectroscopy microscope	HORIBA Scientific	LabRAM HR 800	Prof. Dr. Dietrich Zahn / TU Chemnitz
Atomic force microscope	Agilent Technologies	5420	Prof. Dr. Dietrich Zahn / TU Chemnitz
Tip-enhanced Raman microscope (TERS)	TU Chemnitz	Side illumination setup	Prof. Dr. Dietrich Zahn / TU Chemnitz

IMPLEMENTATION OF THE DCN



- ▶ User policy (finalized 11/2013)
 - ▶ Organizational and financial processes
- ▶ First service requests
- ▶ Development of a communication platform (www.tu-dresden.de/dcn)
- ▶ Joint scientific symposia with Fraunhofer DFCNA
- ▶ Presentations at fairs etc. with Fraunhofer DFCNA
- ▶ Strategic partnerships with equipment suppliers

STRATEGIC PARTNERSHIPS WITH INDUSTRY



DCN EVENTS - REVIEW



Timeline

- ▶ June 2012

Decision of the management of TU Dresden to establish a central analytics center at TUD

- ▶ November 2012

Formation of a key team to start the operation of a locally decentral nanoanalysis center at TUD (phase 1)

- ▶ April 2013

Official opening of the DCN at TU Dresden

APRIL 25, 2013

Official Opening of the DCN at TU Dresden



17 Dresden Center for **Nanoanalysis**



APRIL 26, 2013

1st Nanoanalysis Symposium

Friday, 26 April 2013

1st Dresden Nanoanalysis Symposium

(organized by the Dresden Center for Nanoanalysis [DCN] at TU Dresden and the Dresden Fraunhofer Cluster Nanoanalysis [DFCNA])

09:00 Welcome Address

Ehrenfried Zschech, Fraunhofer IZFP Dresden and Technische Universität Dresden, Germany

09:10 The Stanford Nanocharacterization Laboratory and Recent Applications of the Aberration-Corrected ETEM

Robert Sinclair
Stanford University, Stanford/CA, USA

09:40 Correcting the Chromatic Aberration: PICO and its Applications

Joachim Mayer
Ernst-Ruska-Zentrum Jülich, Germany

10:10 Nanoscale X-ray Spectroscopy and Tomography with Synchrotron Radiation

Gerd Schneider
Helmholtz-Zentrum Berlin, Germany

10:40 Coffee Break with Poster Session

Dresden Center for **Nanoanalysis**

11:45 Nanograin Aluminum - Process, Properties, Nanoanalysis

Malgorzata Lewandowska
Technical University Warsaw, Poland

12:15 Nanotechnology – Accelerating Future Aircraft

Rainer Rauh
EADS München, Germany

12:45 Lunch with Poster Session

14:00 The Future of AFM Technologies in Life Sciences

Christoph Gerber
University of Basel, Switzerland

14:30 Atom Probe Tomography: Some 3D Atomic-Scale Studies of Semiconductors and Catalysts

George Smith
Oxford University, United Kingdom

15:00 Challenges to Structural and Materials Characterization in Leading-Edge Semiconductor Devices

Hans-Jürgen Engelmann
GLOBALFOUNDRIES Dresden, Germany

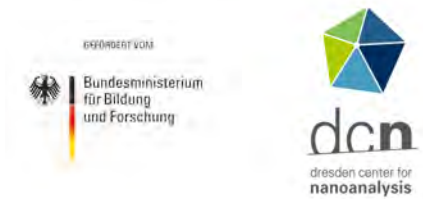
15:30 Closing Remarks

Ehrenfried Zschech, Fraunhofer IZFP Dresden and Technische Universität Dresden, Germany

16:30 Guided Tour at Fraunhofer IZFP / Dresden Fraunhofer Cluster Nanoanalysis



DECEMBER 2, 2013



1st Nanoanalysis Colloquium

ÖFFENTLICHES NANOANALYTIK KOLLOQUIUM
02.12.2013 — 14-17 Uhr
Vortragssaal der SLUB Dresden, Zellescher Weg 18, 01069 Dresden

PROGRAMM

14:00 Begrüßung Ehrenfried Zschech (TU Dresden/DCN)	16:50 Produktzuverlässigkeit und Lebensdauer: Kinetik von Degradationsmechanismen in nanoelektronischen Systemen Ehrenfried Zschech/Oliver Aubeil/Sven Nicolai/Diengquan Liu (TU Dresden) Rauhofer DFCNA, GLOBALFOUNDRIES (Dresden)
14:05 1D-Elektronik Paradiso Coskina (VDI/VDE)	16:10 Neue Geratkonzepte und Optiken für die Nano-Röntgenmikroskopie Thomas Hötz/Werner Dietz/Markus Kämer/Danny Weißbach (VDI GmbH Dresden)
14:10 Künftige Rolle der Nanoanalytik für Material- und Prozessentwicklung in der Halbleiterindustrie Udo Nothelfer (UNTeC - Technology Consulting)	16:30 Magnetoresistive Sensoren für hochgenaue, hochräumliche Messung von Winkel, Weg und elektrischem Strom Ralf Sauer/Gerhard Gombel/Lehrau (TU Dresden)
14:35 Silizium-Nanodrähte als Plattform für rekonfigurierbare Schaltungen und chemische Sensoren Thomas Mikolajick/Walter Weber (TU Dresden)	16:50 Schnappwort Ehrenfried Zschech (TU Dresden/DCN)
15:00 Hochaufgelöste Nanoanalytik für 1D-Elektronik: Elektronen- und Ionenmikroskopie an Nanodevices Markus Löffler/Aranzazu Garitagoitia/Sayanti Banerjee (TU Dresden/DCN)	17:00 Ende
18:20 Kaffepause	

- ▶ 14:00 Uhr: Begrüßung
Ehrenfried Zschech (TU Dresden/DCN)
- ▶ 14:05 Uhr: 1D-Elektronik
Paradiso Coskina (VDI/VDE)
- ▶ 14.10 Uhr: Künftige Rolle der Nanoanalytik für Material- und Prozessentwicklung in der Halbleiterindustrie
Udo Nothelfer (UNTeC - Technology Consulting)
- ▶ 14:35 Uhr: Silizium-Nanodrähte als Plattform für rekonfigurierbare Schaltungen und chemische Sensoren
Thomas Mikolajick/Walter Weber (TU Dresden)
- ▶ 15:00 Uhr: Hochaufgelöste Nanoanalytik für 1D-Elektronik: Elektronen- und Ionenmikroskopie an Nanodevices
Markus Löffler/Aranzazu Garitagoitia/Sayanti Banerjee (TU Dresden/DCN)

- ▶ **15:50 Uhr: Produkt-Zuverlässigkeit und Lebensdauer: Kinetik von Degradationsmechanismen in nanoelektronischen Systemen**
Ehrenfried Zschech/Oliver Aubel/Sven Niese/Zhongquan Liao (TU Dresden, Fraunhofer DFCNA, GLOBALFOUNDRIES Dresden)
- ▶ **16:10 Uhr: Neue Gerätekonzepte und Optiken für die Nano-Röntgentomographie**
Thomas Holz/Reiner Dietsch/Markus Krämer/Danny Weißbach (AXO GmbH Dresden)
- ▶ **16:30 Uhr: Magnetoresistive Sensoren für hochgenaue, hochdynamische Messung von Winkel, Weg und elektrischem Strom**
Rolf Slatter (Sensitec GmbH Lahnau)
- ▶ **16:50 Uhr: Schlusswort**
Ehrenfried Zschech (TU Dresden/DCN)
- ▶ **17:00 Uhr: Ende**

EUROMAT 2013 – Sevilla 8 - 13 September 2013

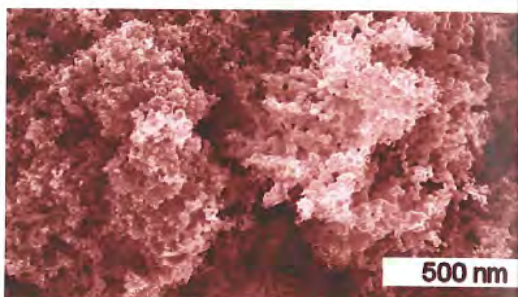


DECEMBER 3-4, 2013

DGM

European Advanced Training Course

Nano-scale Materials and Advanced Characterization Techniques



3-4 Dec 2013

Dresden, Germany

Dresden Fraunhofer Cluster
Nanoanalysis (DFCNA)

Deutsche Gesellschaft
für Materialkunde e.V.

supported by
The Federation of European
Materials Societies (FEMS)

FEMS

Speakers / General Information

Chairman of the seminar is
Prof. Dr. Ehrenfried Zschech,
Dresden Fraunhofer Cluster Nano-
analysis, Germany.

The seminar takes place at the
Fraunhofer Institute for Nonde-
structive Testing Dresden branch
(IZFP-D), Maria-Reiche-Straße 2,
01109 Dresden (Germany).

Further speakers are:

Prof. Dr. Didier Blavette
University Rouen, Elbeuf, France

Prof. Dr. Lukas M. Eng
Dr. Juergen Gluch
Dr. Georg Oertel
Technical University Dresden,
Germany

Dr. Marianne Guicheney
Plastic Logic GmbH, Dresden,
Germany

Dipl.-Ing. Joerg Heber
Dr. Jan-Uwe Schmidt
Fraunhofer IPMS Dresden,
Germany

Dr. Eckhard Langer
GLOBALFOUNDRIES Dresden,
Germany

Dipl.-Phys. Andre Clausner
Dr. Uwe Muehle
Dipl.-Ing. Sven Niese
Fraunhofer IZFP Dresden, Germany

Dr. Annegret Potthoff
Fraunhofer IKTS Dresden, Germany

Participation fee:
1.150,- EURO

Fee for Members of the DGM:
Personal members or 1 non-
member from a member institute /
member company: 1.050,- EURO

The fee includes:

- Attendance of the seminar sessions
- Comprehensive handouts
- Refreshments during the coffee breaks
- Lunch and dinner*
(* incl. 19% VAT)

Cancellation policy:
Any cancellation is subject to
a cancellation fee of 50% of the
fees involved. After 30 October
the entire fee is due. Substitution
is possible at any time.

For further information please
contact:

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UPCOMING EVENTS

► July 2, 2014

2nd Dresden Nanoanalysis Symposium
together with the 10th Nanofair

The poster is for the 2nd Dresden Nanoanalysis Symposium (DNS). It features a green background with white text and logos. At the top right, there is a logo for 'dcn dresden center for nanoanalysis'. The main title is '2nd DRESDEN NANOANALYSIS SYMPOSIUM (DNS)'. Below the title, it says 'July 2, 2014 — 09:00–18:30' and 'Internationales Congress Center Dresden Ostra-Ufer 2, 01067 Dresden'. The text describes the symposium as a forum for presenting current research and for discussions on issues related to nanoanalysis and its applications in materials science and engineering, advanced electronics, energy research and other fields. It mentions that the spirit of previous workshops, new research results and advances in basic understanding will be emphasized. Participants of the 2nd DNS are also invited to visit the Nanofair 2014 event. The poster also includes a QR code, the Fraunhofer logo, and the registration link 'www.nanoanalysis.dresden.de'. At the bottom, there are logos for 'cf aed', 'TECHNISCHE UNIVERSITÄT DRESDEN', and 'DRESDEN concept'.

DCN WORKING GROUP – CONTACTS



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