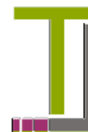
2.3.4 Micro and Nano Characterisation

Lecturer	Christian Kübel
Content	Introduction to Transmission Electron Microscopy and its use in materials sciences
Course Objectives	Basic understanding of TEM operation, image formation and analytical TEM techniques to understand its use for materials characterization.
Learning Targets/ Skills	Basic of BF/DF-TEM, HRTEM, HAADF-STEM and EELS/EDX analysis
Pre-Requisites	Basic knowledge in Materials Sciences and Wave Optics
Teaching Method	3h lecture + 1h practical demonstration
Course Material	Printed lecture notes
Literature	Williams & Carter, Transmission Electron Microscopy
Contact Lecturer	christian.kuebel@kit.edu

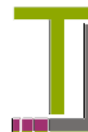
Lecturer	Ruth Schwaiger
Content	Focused Ion Beam systems for imaging and fabrication in materials science
Course Objectives	This course will give an introduction to the basic principles of ion beam systems, the interactions of ions with materials, etching, and deposition.
Learning Targets/ Skills	Basic understanding of FIB and HIM operation, image formation and characterization methods
Pre-Requisites	Basic knowledge in Materials Science
Teaching Method	2h lecture + 2h practical demonstration
Course Material	Printed lecture notes (Powerpoint slides as handouts during the course)
Literature	Focused Ion Beam Systems (Nan Yao, Ed.) Scanning – Special Issue: Helium Ion Microscopy Volume 34, Issue 2, Pages 83–134, David C. Bell (Ed.)
Contact Lecturer	ruth.schwaiger@kit.edu

Lecturer	Michael Bruns
Content	Surface analysis of inorganic and organic materials with X-ray Photoelectron Spectroscopy (XPS)
Course Objectives	Learning fundamental aspects of XPS using state-of-the-art instrumentation
Learning Targets/ Skills	Basics, strengths and limitations of XPS. Overview of data acquisition and processing. Necessity to combine independent methods to achieve a comprehensive characterization, in particular using complementary ToF-SIMS.
Pre-Requisites	Basic knowledge in physics and chemistry.
Teaching Method	Seminar, hands-on included
Course Material	Transparencies
Literature	• John F. Watts and John Wolstenholm, An Introduction to Surface Analysis by XPS and AES, John Wiley and Sons Ltd, UK, 2003 • D. Briggs and J. T. Grant (Eds.), Surface Analysis by Auger and X-ray Photoelectron Spectroscopy, IM Publications, Chichester, West Sussex, UK 2003
Contact Lecturer	michael.bruns@kit.edu



Lecturer	Alexander Welle
Content	Surface analysis of inorganic and organic materials with Time-of-Flight Secondary Ion Mass Spectrometry (ToF-SIMS)
Course Objectives	Basics, strengths and limitations of RoF-SIMS Necessity to combine independent methods to achieve a comprehensive characterization, in particular using complementary XPS.
Learning Targets/ Skills	Ability to judge the applicability of SIMS to a special analytical question Understanding the strengths and limitations of SIMS
Pre-Requisites	Basic knowledge in physics and chemistry (Basic knowledge on mass spectrometry in general)
Teaching Method	Seminar
Course Material	Presentation slides
Literature	Belu, Anna M., Graham, Daniel J., Castner, David G.; Time-of-flight secondary ion mass spectrometry: techniques and applications for the characterization of biomaterial surface, Biomaterials 24 (21) (2003) 3635-3652 DOI: 10.1016/S0142-9612(03)00159-5
Contact Lecturer	Alexander.Welle@kit.edu

Lecturer	Richard Thelen
Content	Introduction to Atomic Force Microscopy
Course Objectives	Getting familiar with the principles, advantages and limitations of AFM
Learning Targets/ Skills	How to deal with structures and their characterization even in sub µm range
Pre-Requisites	Basic knowledge of physics/optics
Teaching Method	Hands on lab class
Course Material	Will be distributed during the course
Literature	
Contact Lecturer	Richard.thelen@kit.edu



Lecturer	Julia N. Wagner
Content	Introduction to 3D Atom Probe Tomography
Course Objectives	This introductory course will give an overview about the technique of atom probe tomography - one of the key instruments of future materials analysis. Atom probe tomography utilizes a three dimensional approach with high resolution and accuracy, where the real space position of individual atoms will be revealed. The course will lead you through the beginnings of the method where information was gathered on only a few hundred atoms to the current state-of-the-art instruments with the ability to collect data from hundreds of millions of atoms. The theoretical introduction is followed by a hands-on training on one of the latest 3D Atom Probe Instruments in the world to experience the power of the method on your own.
Learning Targets/ Skills	Basic understanding of the atom probe method and its application First experiences in performing experiments by this method
Pre-Requisites	Basic knowledge of physics
Teaching Method	lecture – theoretical part (2 hours) • Basics APT • Sample preparation • Challenges • Application examples • Introduction to hands-on training Hands-on training (2 hours)
Course Material	
Literature	• Larson D.J., Prosa T.J., Ulfig R.M., Geiser B., Kelly T.F.: Local Electrode Atom Probe Tomography, Springer, New York, 2013. • Gault, B., Moody, M.P., Cairney, J.M., Ringer, S.P.: Atom Probe Microscopy, Series: Springer Series in Materials Science, Vol. 160, 2012.
Contact Lecturer	Julia.wagner@kit.edu