Join us and an impressive panel of guest speakers for Bruker's 2022 AFM User Meeting. The focus of this year's meeting is the use of AFM for high-resolution imaging and the nanochemical, nanomechanical and nanoelectrical characterization of advanced materials.

Program - Wednesday, March 23rd, 2022 | 13:00 GMT | 14:00 CET

14:00 Welcome & Introduction
Dr Peter De Wolf, Worldwide Application Director, Bruker Nano Surfaces & Metrology

14:05 Latest Bruker AFM Developments
Dr Mickael Febvre, Application Manager Europe, Bruker

Session 1: Semiconductors & Nanoelectrical Applications

14:15 Nanoscale Electrical Characterisation of Nitride Transistor
Prof Rachel Oliver, University of Cambridge, UK

14:35 The Use of AFM Electrical Modes (SCM, SSRM and sMIM) in the Characterization of Dies and Semiconductor Materials
Dr Rosine Coq Germanicus, CRISMAT laboratory, ENSICAEN, France

14:55 Analysis of Fuel Cell and Electrolyzer Components with Nanoelectrical and Nanomechanical AFM
Dr Tobias Morawietz, German Aerospace Center (DLR), Germany

15:20 Live Bruker Demonstration
Dr Vishal Panchal, Application Scientist, Bruker

15:35 Coffee Break

Session 2: Nanomaterials Research

15:40 AFM-IR Insights into the Nanoscale Polymer Interphase
Dr Suzanne Morsch, University of Manchester, UK

16:00 Direct Observations of Mineral-Fluid Reactions using Atomic Force Microscopy
Dr Encarnación Ruiz Agudo, University of Granada, Spain

16:20 Mechanical Mapping of Lignocellulosic Surfaces
Dr Claudia Gusenbauer, University of Natural Resources and Life Sciences, Austria

16:40 Bruker Demonstration: Dimension IconIR
Dr Miriam Unger, Application Manager, Bruker

16:50 Q&A and Closing
Dr Peter De Wolf

Please don't hesitate to contact us at productinfo.emea@bruker.com if you have any questions.

Abstracts and Speakers

Nanoscale Electrical Characterisation of Nitride Transistors

Rachel Oliver, Professor of Materials Science, Director of the Cambridge Centre for Gallium Nitride, University of Cambridge, UK

High electron mobility transistors (HEMTs) based on gallium nitride offer outstanding performance in terms of both efficiency in power conversion and switching frequency for high speed applications. However, their ultimate performance is limited by defects and nanoscale inhomogeneities. Techniques based on atomic force microscopy that access a sample's electrical properties allow the identification of nanoscale features which perturb the performance of the device. Both plan view measurements addressing the surface of the device structure, and cross-sectional measurements accessing sub-surface layers are shown to allow the diagnosis of problems with material growth, and hence provide a route to improve devices.

Prof Rachel Oliver is a materials scientist, inventor and spinout founder who also campaigns for equity in science and engineering research. Her passion for understanding and engineering the small-scale structure of materials to enable new technologies has been recognised by the award of a Fellowship of the Royal Academy of Engineering in 2021 and her selection as an IEEE Photonics Society Distinguished Lecturer.

The Use of AFM Electrical Modes (SCM, SSRM and sMIM) in the Characterization of Dies and Semiconductor Materials

Rosine Coq Germanicus, Assoc. Prof., CRISMAT laboratory, ENSICAEN Research Center, France

Nowadays, in highly integrated microelectronic devices, heterogeneous materials are used in the design of functional dies, semiconductor materials, alloy metals, dielectric films for front-end processing, and composite materials for packaging systems. Reliability and failure analysis requires the characterization, detection and quantification of the 2D-local properties with high spatial resolution. This talk will focus on the investigation of the topography and local mechanical properties of Epoxy Molding Compound (EMC) using the AFM mode PF-QNM. This will be followed an outline of metrological approaches for the detection of the charge carrier and analysis of the carrier type and defect densities at the die and wafer levels using the electrical modes SSRM, SCM and sMIM.

Rosine Coq Germanicus is an Associate Professor at the CRISMAT laboratory (France). After completing a university degree in physics in Guadeloupe, she received her doctoral thesis at the University Montpellier (France), where she investigated the effect of space radiation on optoelectronic devices. She then joined the common laboratory at NXP and Presto-Engineering and is now at the academic lab CRISMAT. The focus of her current research activity is the application of scanning probe microscopy to investigate microelectronics and radiation effects, including nano-electrical and nano-mechanical characterization, as well as the reliability of integrated semiconductor devices.

Analysis of Fuel Cell and Electrolyzer Components with Nanoelectrical and Nanomechanical AFM

Dr Tobias Morawietz, German Aerospace Center (DLR), Stuttgart, Germany

Electrochemical energy converters are becoming increasingly important in the near future as the transition to sustainable energy sources is progressing. To improve these technologies, a precise knowledge about their structure and functionality at the nanoscale is crucial. This talk will provide an insight into the application of nanoelectrical and nanomechanical atomic force microscopy for the analysis of fuel cells and electrolysis components. In particular, spatially resolved imaging of the different constituents and structural analysis of the complex catalytic layers will be discussed.

Tobias Morawietz studied Bio- and Nanotechnologies at the University of Applied Sciences Südwestfalen (Germany) (B.Sc.) and then Applied Surface and Material Sciences (M.Sc.) in Esslingen (Germany). After working in the corrosion protection laboratory and the atomic force microscopy laboratory, Tobias Morawietz started his doctoral thesis on atomic force microscopy on PEMFC at the University of Stuttgart (Germany) and successfully defended it in 2021. He is currently working on electrolysis materials at the German Aerospace Center in Stuttgart and on the analysis of fuel cell materials at Esslingen University of Applied Sciences. (https://orcid.org/0000-0003-2291-9360).

AFM-IR Insights into the Nanoscale Polymer Interphase

Dr Suzanne Morsch, Department of Materials, University of Manchester, UK

Network-forming polymers are widely used in advanced composites, structural adhesives, protective paints, and coatings. In all of these applications, interactions with an inorganic surface occur, both during and following step growth polymerisation, leading to the formation of distinct interphase regions. The structure of this interphase is widely considered to be critical to performance, however, these buried nanoscale regions are largely inaccessible to conventional organic analysis techniques. Here, we show how the application of AFM-IR in this field has generated new insights into the formation, chemistry, and degradation of the buried interphase.

Dr Suzanne Morsch obtained her PhD in Surface Science from the University of Durham in 2013. Since then, she has worked as a Research Associate, and more recently Research Fellow at the AkzoNobel Laboratory for Corrosion Protection in the Department of Materials at the University of Manchester, focused on the mechanisms of polymer degradation in protective paints, with an emphasis on nanostructural analysis using AFM-IR

Direct Observations of Mineral-Fluid Reactions using Atomic Force Microscopy

Encarnación Ruiz Agudo, Asst. Prof., Department of Mineralogy and Petrology, University of Granada, Spain

AFM enables the in situ observation of mineral-fluid reactions at the nanoscale. Over the past 20 years, the direct observation of mineral surfaces during dissolution and growth at molecular resolution has made significant contributions toward improving our understanding of the dynamics of mineral-fluid reactions at the atomic scale. The observation and kinetic measurement of dissolution and growth in AFM experiments provides valuable evidence for crystal dissolution and growth mechanisms. In this talk, examples on the information generated by AFM studies on the dissolution and growth of minerals will be depicted, including the influence of fluid characteristics such as supersaturation, solution stoichiometry, pH, temperature, and the presence of impurities.

Dr Ruiz Agudo, a Chemical Engineer, received her doctorate in 2007 in the Earth Sciences Doctorate Program. She has received several awards, including the Arne Richter Award for Outstanding Young Scientists of the European Geosciences Union (2012) and the European Mineralogical Union Research Excellence Medal (2014). Her research focuses on understanding the processes of dissolution, growth and mineral replacement, as well as the effect of organic compounds in them using in-situ techniques such as AFM. This has diverse applications including the protection of ornamental materials used in built heritage, the cement industry, biomineralization processes and CO2 capture through carbonate mineralization.

Mechanical Mapping of Lignocellulosic Surfaces

Dr Claudia Gusenbauer, Department of Material Sciences and Process Engineering (MAP), University of Natural Resources and Life Sciences, Austria

Lignocellulosic resources are characterized by their high availability and excellent mechanical properties at low weight. Wood is an important resource for lignocellulose and can be treated with various modification protocols that require parallel screening, also of nanoscale properties. We apply atomic force microscopy to scan the mechanical properties of wood ultrastructures and visualize its chemical surface behaviour with high spatial resolution. In addition, we are able to study comparatively rough wood substrates in different challenging conditions, such as in temperature- or pH-changing fluids. Nanoscale mapping allows us to improve the fundamental understanding of natural wood surfaces to support the development of lignocellulosic products

In her PhD, Claudia Gusenbauer studied the fundamental chemical surface behavior of wood nanostructures and investigated the performance of functionalized wood materials based on scanning probe microscopy techniques. She holds a master's degree in Wood Technology & Management and started a post-doctoral position at the University of Natural Resources and Life Sciences (BOKU), Vienna, Austria in January 2021, where she continues investigating the nano-structural design of wood materials towards the fabrication of functional wood materials.