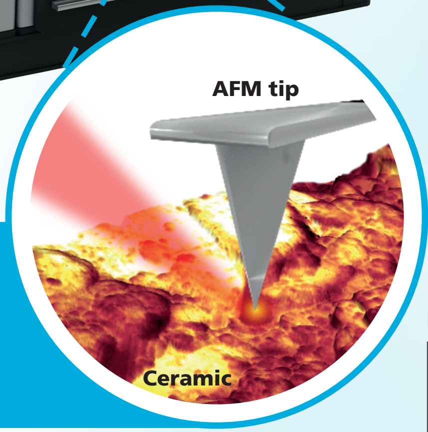
E-Book

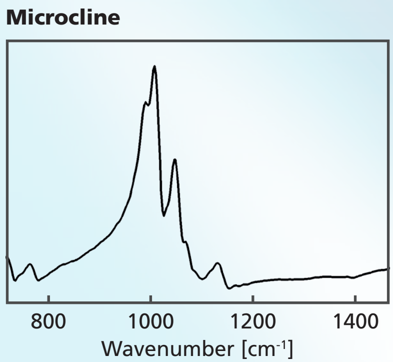
nanoscale analysis of inorganic materials

The neaSNOM performs super-resolution imaging and spectroscopy to identify the composition of ceramics or minerals with nanometer precision using their material-specific infrared spectroscopic signatures.



Chemical identification at 10 nm spatial resolution

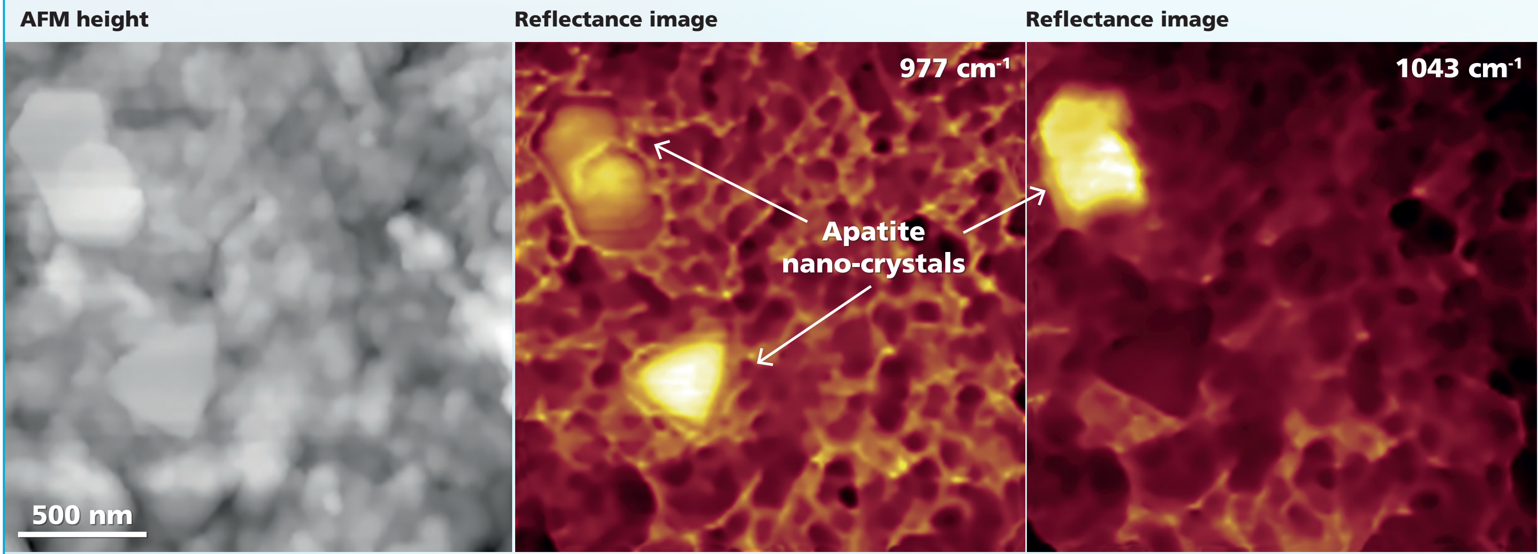
see the nanoworld
nea spec



Mineral identification by nano-FTIR: Characteristic vibrational near-field spectrum of e.g. microcline in a piece of ancient ceramics dated ca. 4000 BC

Structure and composition analysis of human bone at the nanoscale

neaSNOM is based on tapping-mode AFM and uses low radiation densities to perform gentle noninvasive nanoimaging and nano-FTIR spectroscopy. It delivers highest detection sensitivity at sub-10 nanometer resolution – independent of sample composition and thickness.



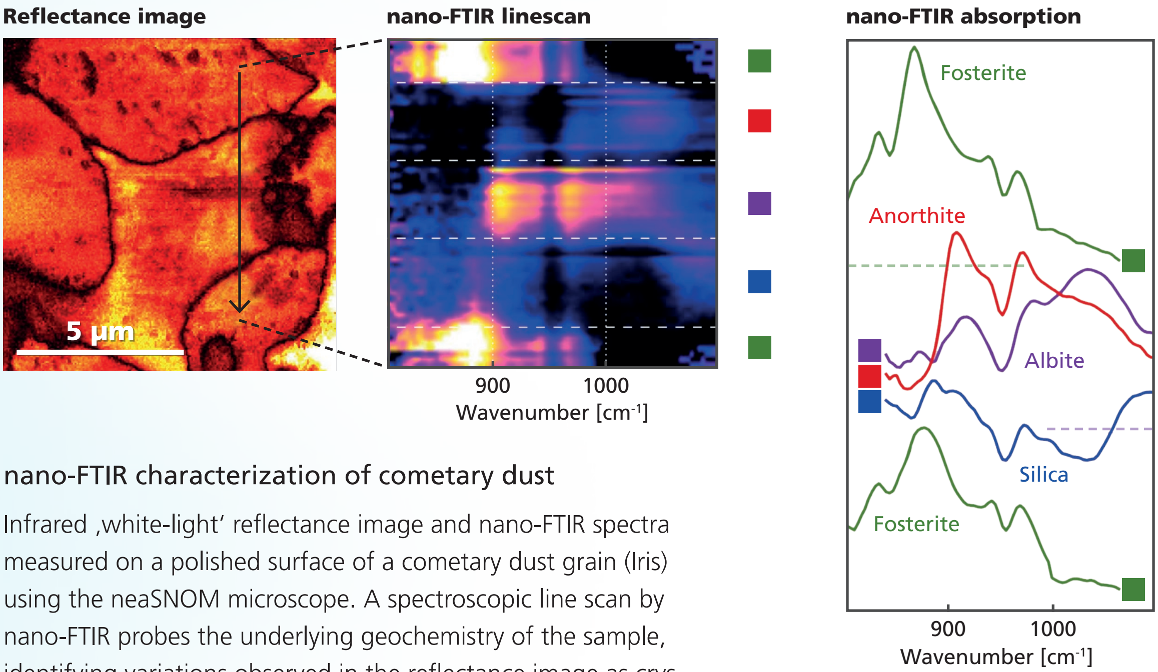
IR nanoscopy reveals nature's biochemial control of the mechanical properties of bone

Minerals in human bone

High resolution IR nanoscopy image obtained simultaneously with the AFM topography shows the nanoscale distribution of Calcium phosphate and collagen within the cross section of a human bone lamella extracted from a hip joint. Imaging at different wavelengths maps different minerals within the tissue, which reveals important information about the bone structural integrity and could provide details about the process of demineralization due to diseases, such as osteoporosis.

Nanoscale analysis of the chemical structure of chondrites and comets

Broadband nano-FTIR spectroscopy and hyperspectral imaging perform nanoscale chemical analysis of any AFM-ready sample. The nano-FTIR spectra can be directly compared to standard databases allowing for straightforward chemical identification.



nano-FTIR characterization of cometary dust

Infrared ‚white-light' reflectance image and nano-FTIR spectra measured on a polished surface of a cometary dust grain (Iris) using the neaSNOM microscope. A spectroscopic line scan by nano-FTIR probes the underlying geochemistry of the sample, identifying variations observed in the reflectance image as crystalline and amorphous materials coexisting at the micron scale. These findings are indicative of a rapid cooling from a melt and provide evidence for a high temperature formation of comets.

nature COMMUNICATIONS

G. Domingues et al., Nature Comm. 2014, 5, 5445.

nano-FTIR provides evidence for common high-temperature formation history of chondrits and comets

Direct observation of delithiation in Li-ion battery electrode materials at the nanoscale

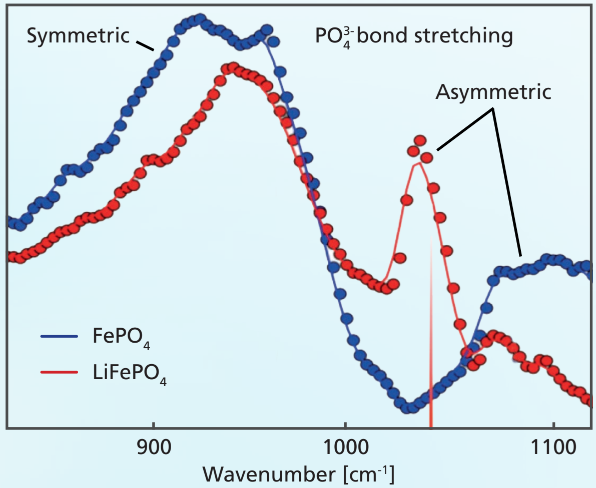
nano-FTIR spectroscopy and nanoimaging allow for monitoring chemical processes with 10 nm spatial resolution and unique capability of performing nondestructive subsurface tomography, yielding crystal orientation in 3D among others.

Delithiation of $LiFePO_4$

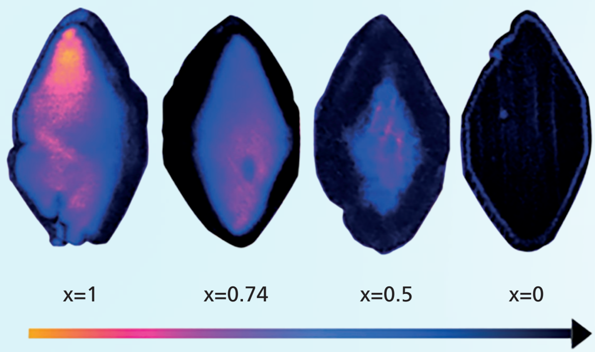
nano-FTIR spectroscopy and IR nanoscopy of Li-ion battery electrode material provide direct evidence for the coexistence of $LiFePO_4$ and $FePO_4$ phases in partially delithiated microcrystals. Surrounded by a $FePO_4$ shell, the diamond-shaped $LiFePO_4$ inner core gradually shrinks in size upon delithiation of the Lithium iron phosphate crystal. This data reveals information about the charge & discharge performance of conventional Li-ion electrode materials and relates their electrochemical efficiency to material design.

I. T. Lucas et al., Nano Lett. 2015, 15, 1.

nano-FTIR reflectance



Li concentration maps in Li_xFePO_4 microcystals

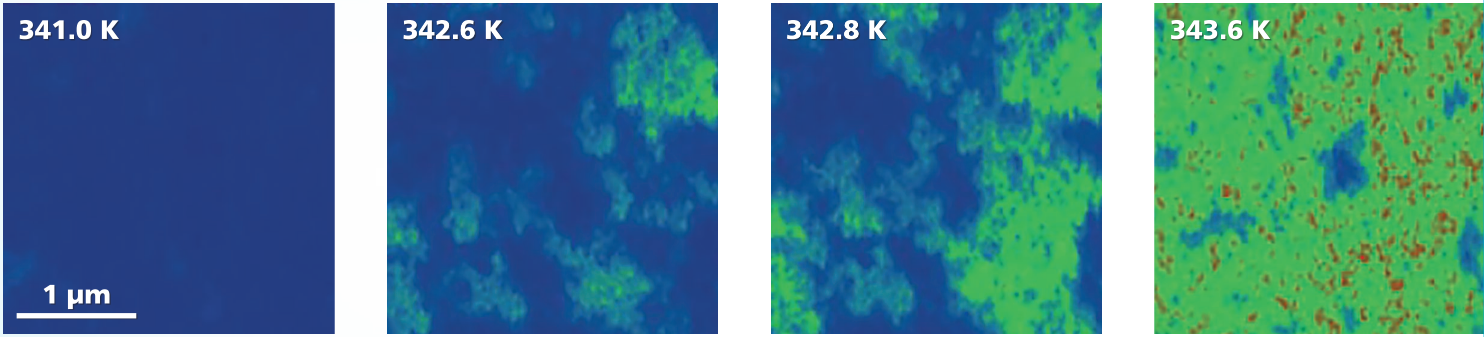


neaSNOM enables the development of more efficient energy storage materials

Real-space mapping of the insulator-to-metal transition in vanadium dioxide

IR nanoimaging directly maps the free carrier concentration at the nanoscale, providing strong contrast between conductive and insulating phases. The method is completely non-invasive and free of any artifacts due to mechanical or thermal crosstalk.

Reflectance image



IR nanoscopy provides fundamental insights into phase transitions in strongly correlated materials

Insulator to metal phase transition in VO_2

IR nanoscopy images recorded at representative sample temperatures during the insulator-to-metal phase transition of vanadium dioxide (VO_2). Upon heating, nanoscale metallic regions nucleate (green), then grow with increasing temperature, and eventually connect. Such measurements provide new insights into VO_2 by disentangling structural & electronic properties and reveal information about the influence of local strain or defects on the localization of electrons.

M. A. Huber et al., Nano Lett. 2016, 16, 1421.

M. Lewin et al., Appl. Phys. Lett. 2015, 107, 151902.

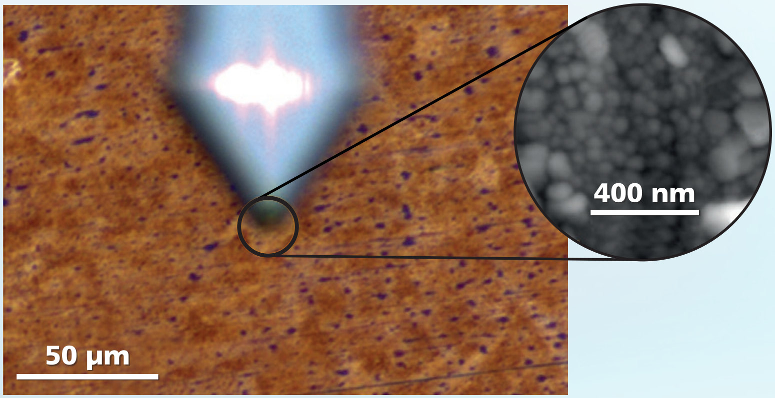
S. Gilbert Corder et al., Nature Comm. 2017, 8, 1471.

M. Qazilbash et al., Science 2007, 318, 1750.

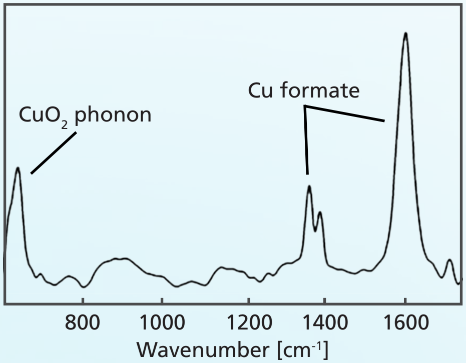
Investigation of copper surface corrosion and Octadecanethiol corrosion inhibitors

Patented nano-FTIR technology delivers broadband spectroscopy from the mid-IR to the visible at the 10 nanometer scale. State-of-the-art interferometric detection provides ultra-high sensitivity and allows for reliable recording of artifact-free absorption and reflection spectra even from a single monolayer.

Optical image **AFM height**



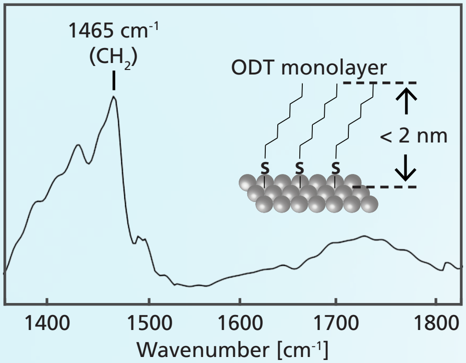
Copper nano-FTIR absorption



Copper surface corrosion

Optical and AFM image of corroded copper featuring nanoscale grains at the surface. Unmatched spectral bandwidth of nano-FTIR allowed chemical identification of the grains as corrosion products featuring strong absorbance from the CuO_2 phonon and Cu formate. Surface protection by Octadecanethiol (ODT) monolayer was tested as a corrosion inhibitor. The ODT can be clearly identified by the CH_2 bending vibration and its functionality demonstrated by the absence of Cu formate peaks at 1600 cm^{-1}.

Copper-ODT nano-FTIR absorption



nano-FTIR demonstrates the effectiveness of ODT as corrosion inhibitor

ELSEVIER

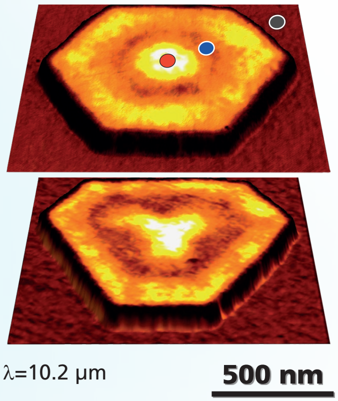
C. M. Johnson et al., Corrosion Science 2016, 108, 60.

Direct mapping of the electronic heterogeneity in Bi_2Se_3 nanocrystals

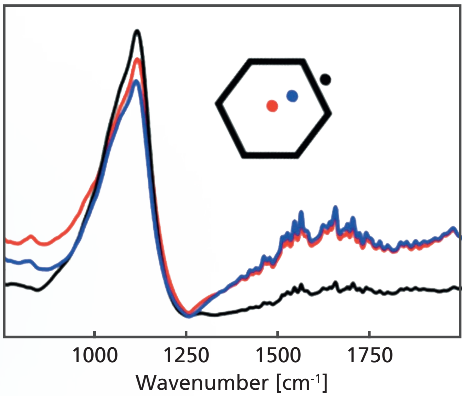
nano-FTIR spectroscopy and IR nanoimaging probe true charge carrier densities at the nanoscale and allow for quantitative extraction of carrier concentration in topological insulators and other quantum materials.

neaSNOM is a valuable control tool for synthesis of defect-free quantum materials

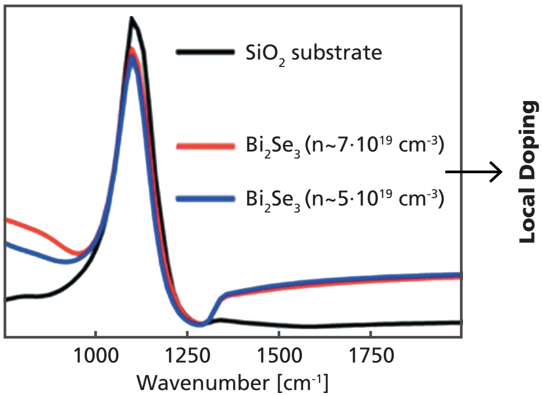
Reflectance image



nano-FTIR reflectance (experiment)



nano-FTIR reflectance (simulation)



Carrier distribution in Bi_2Se_3 nanocrystals

IR nanoscopy and nano-FTIR spectroscopy of polyol-synthesized Bi_2Se_3 and Sb_2Te_3 nanocrystals reveal the existence of local carrier concentration variations below the detection sensitivity of other generally used characterization methods. The observed inhomogeneity of carrier concentration is attributed to the formation of intrinsic defects during synthesis. Thus, IR imaging and spectroscopy provide means for synthesis optimization, which is crucial to obtain topological insulators with specific intrinsic properties.

X. Lu, et al,
Adv. Electron. Mater.
2018, 4, 1700377

Revolutionizing nanoscale analytics

neaspec designs, manufactures and distributes advanced nanoscale optical imaging & spectroscopy microscopes.

The company was founded with the ultimate goal to enable technological & scientific progress in every lab around the world.