

E-Book

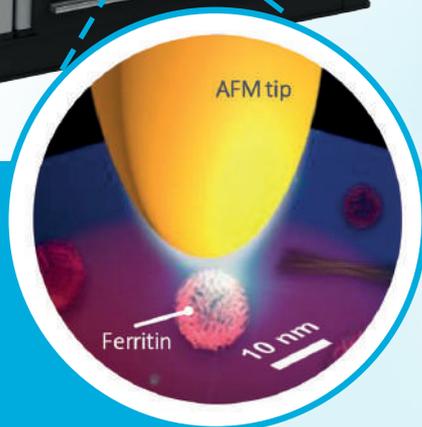
nanoscale characterization of bio-materials

neaSNOM microscope combines the analytical power of FT-IR spectroscopy and IR microscopy with the spatial resolution of AFM gaining direct access to the composition and organization of biological samples at the nanoscale.

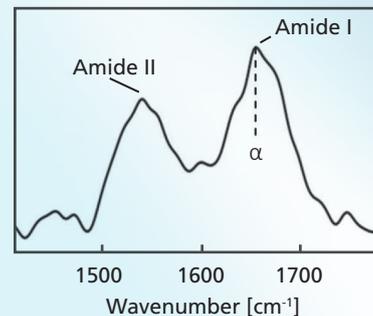


see the nanoworld
nea!spec

Infrared spectroscopy of individual macromolecules at 10 nm spatial resolution



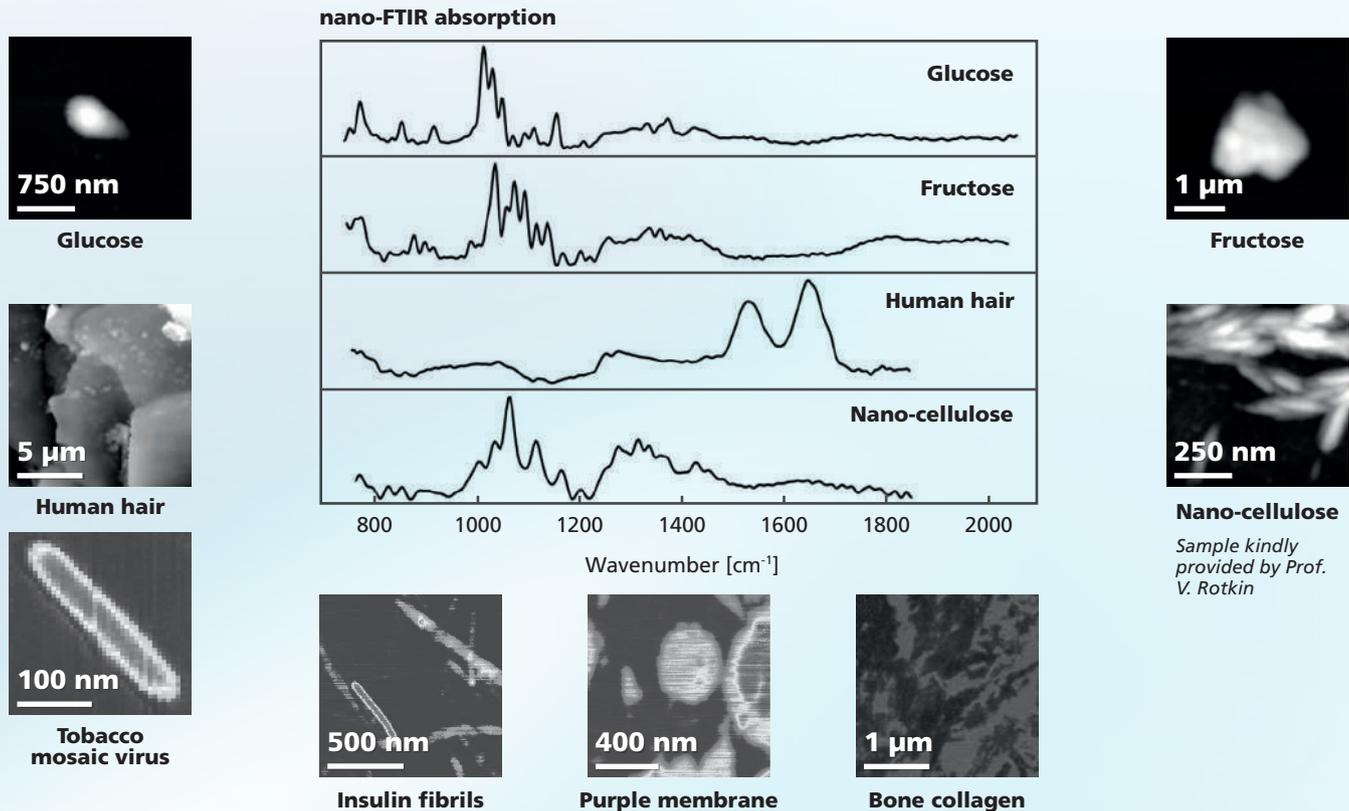
nano-FTIR absorption of Ferritin



Ferritin macromolecule:
24 subunits
ca. 5000 C=O bonds
ca. 1 attogram mass
12 nm diameter

Spectroscopic chemical and structural nanoanalysis of complex biomolecules

neaSNOM complements AFM with label-free nanoimaging, TERS and nanoscale FT-IR (nano-FTIR) that covers the whole mid-IR fingerprint region, thus providing comprehensive characterization of biomaterials chemistry in any AFM-ready biological sample with sub-10 nm spatial resolution.

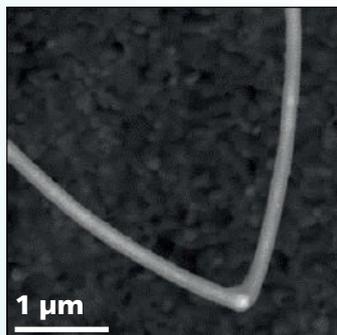


nano-FTIR enables complete physicochemical characterization of biomaterials at the nanometer scale

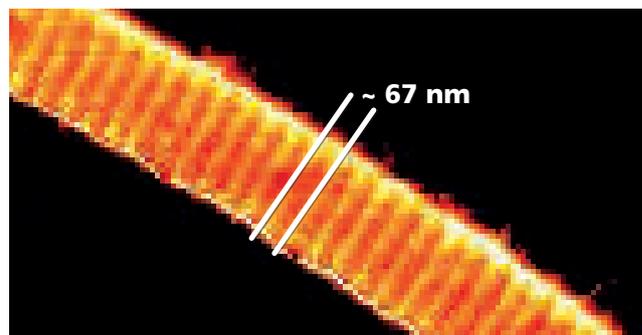
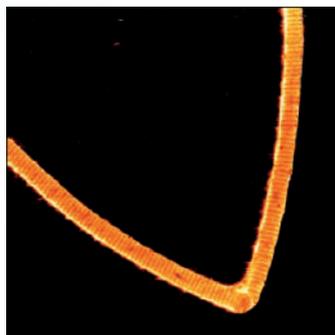
Examining molecular stagger in individual collagen fibrils at the 10 nm scale

Ground breaking technology of neaSNOM provides unsurpassed single molecule sensitivity while using low illumination powers to prevent damage of fragile biological matter, allowing for composition and organization mapping in complex biological structures at the nanoscale.

AFM height



Amide I absorption image



neaSNOM reveals pre-rupture disorder in collagen fibrils of a damaged tendon

Collagen fibril structure

High-resolution IR image of an individual collagen fibril in mammalian tendon clearly resolves the characteristic D-banding structure with a period of ~67 nm related to the amide group orientation. Changes in this period indicate tension, while its absence indicates poor surface shell ordering and is typical for overload damage. Thus, IR nanoscopy provides critical information about diseases associated with protein destruction and aggregation at the most fundamental level.

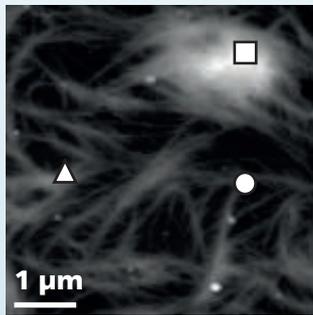


*R. Wiens et al.,
Faraday Discuss.
2016, 187, 555.*

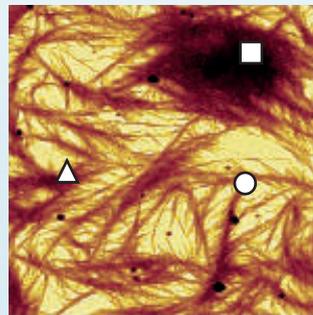
Secondary structure analysis of individual amyloid fibrils

nano-FTIR can perform amide spectroscopy with 10 nm spatial resolution, going far beyond spatial and ensemble-averaged measurements of conventional FT-IR and revealing the composition and conformation of individual proteins.

AFM height

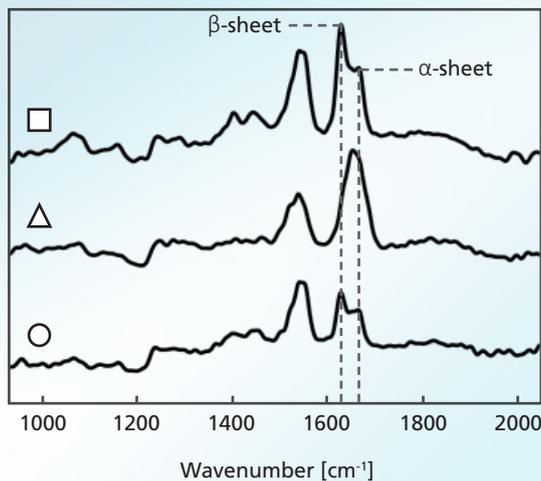


Reflectance image



nano-FTIR investigates protein aggregation caused by amyloid disease

Fibril nano-FTIR absorption



Aggregation of β-amyloid fibrils

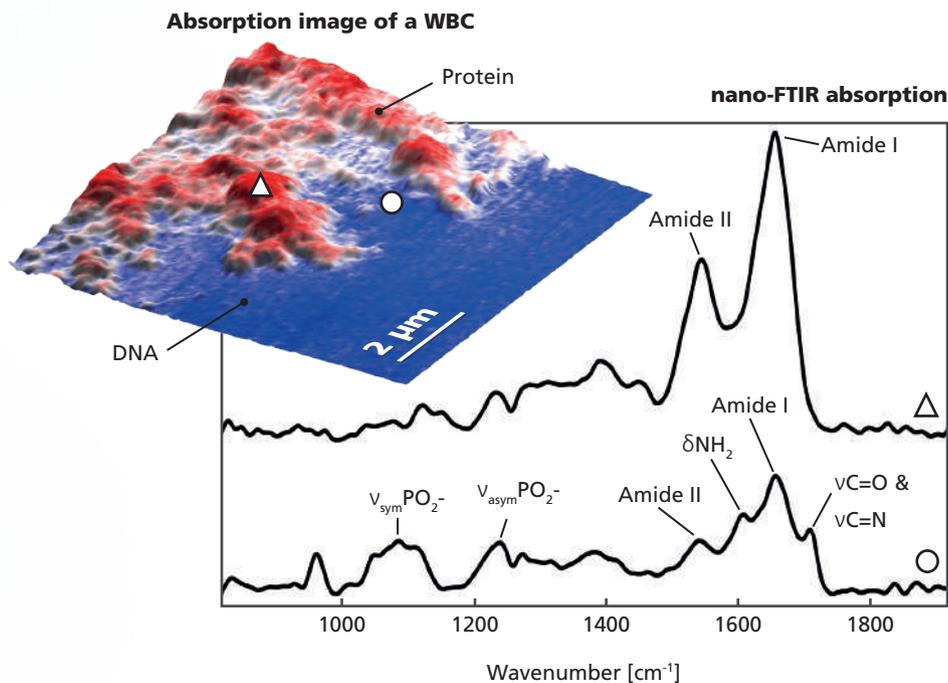
nano-FTIR spectroscopy reliably differentiates between β-amyloid fibrils with dominating α-helix and β-sheet structure by analyzing their Amide I band structure. The nanoscale observation of β-sheet formation in such aggregated proteins is crucial for the investigation of amyloid diseases such as Alzheimer's or mad cow disease, and for the respective drug-development. *Sample kindly provided by Prof. G. Grundmeier, Paderborn, Germany.*

Nanoscale analysis of a lymphocyte nuclei by spectrochemical IR nanoimaging

neaSNOM is a single ready-to-use imaging and spectroscopy tool for non-invasive analysis of organization and morphology in biological specimens at the 10 nm length scale.

DNA distribution in white blood cells

IR image acquired by neaSNOM shows the map of protein and DNA rich regions within a white blood cell (WBC) overlaid with topography. nano-FTIR spectra in the thinner region (blue) show the signature of single- and double-stranded DNA, suggesting that this region is a nuclear pore. Thicker regions show no evidence of nucleic acid bands, identifying the protein-rich interphase chromosome territories that are often associated with the development of diseases, such as classical Hodgkin's Lymphoma. *Measurements done in collaboration with Prof. Kathleen Gough, Manitoba, Canada.*



G. C. Ajaezi et al.,
Analyst
2018, 143, 5926

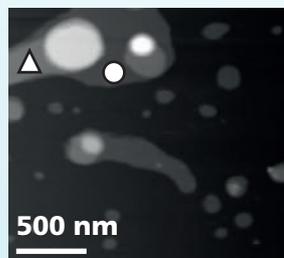
neaSNOM elucidates the nuclear organization of white-blood cells

Sub-monolayer IR nanoanalysis of single phospholipid bilayers

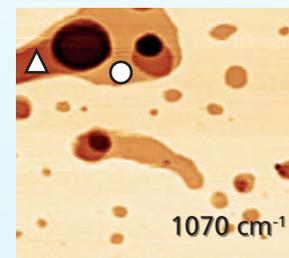
nano-FTIR senses intrinsic optical properties, enabling a detailed analysis of molecular properties without perturbations associated with labeling by extrinsic chromophores. Market-leading data quality, sub-monolayer sensitivity and 10 nm spatial resolution can deliver precise chemical composition, orientation and ordering in molecular monolayers.

nano-FTIR brings closer a complete description of biochemistry in cell membranes

AFM height



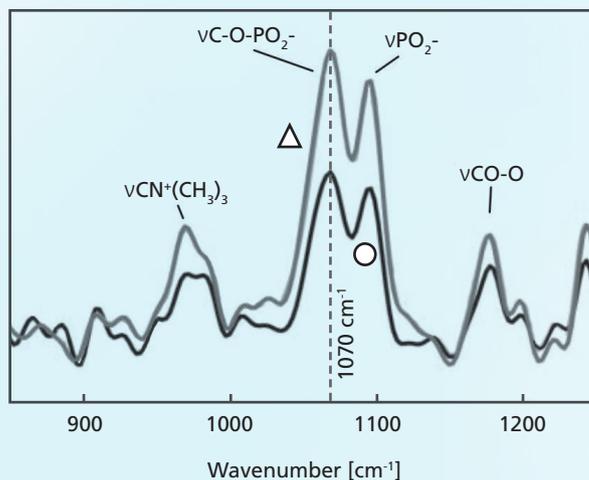
Reflectance image



Biochemistry of phospholipids

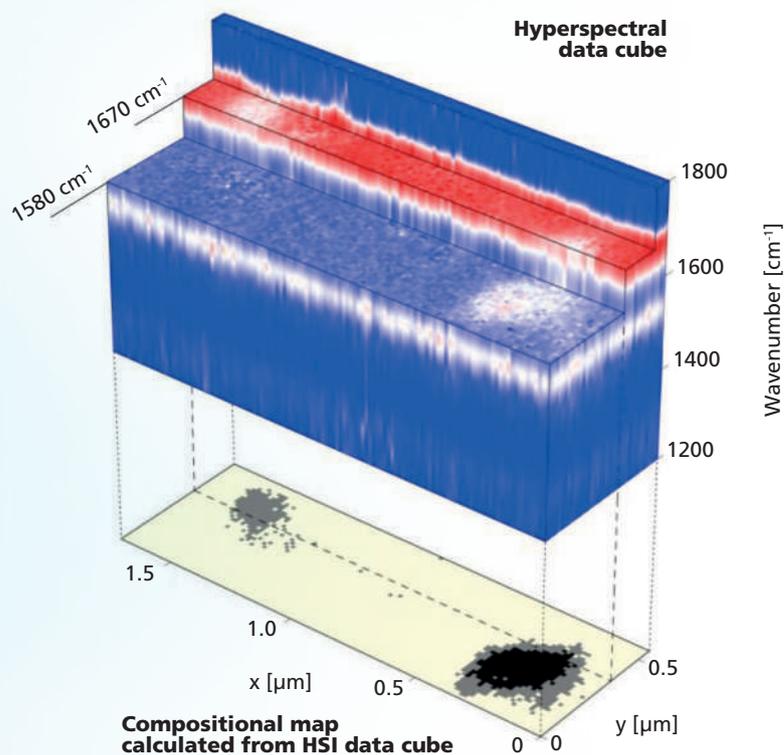
nano-FTIR spectra measured on phospholipid bilayers exhibit characteristic vibrations matching standard ATR-FT-IR references and allow for differentiating 5 nm single- from 10 nm double-bilayers. Quantitative analysis of anisotropy in absorption bands from headgroups and alkyl chains confirms a high degree of molecular ordering and orientation within the single monolayer. Nanoscale probing of this degree can be used to detect phase transitions and interactions with proteins or exogenous molecules, opening a way to the nanoscale characterization of biological membranes. *In collaboration with Dr. L. Quaroni, Krakow, Poland.*

nano-FTIR absorption of phospholipids



In situ analysis of native melanin in the human hair medulla by nano-FTIR hyperspectral imaging

nano-FTIR hyperspectral imaging (HSI) records high-quality broadband spectra at every pixel that are suitable for multivariate data analysis using standard routines for FT-IR spectroscopy, providing a comprehensive understanding of complex biostructures at the nanoscale.



Mapping melanin in human hair

Infrared hyperspectral data cube (containing several thousand spectra, partially cut at different frequencies for improved visibility) collected on a human hair medulla cross-section is evaluated by the multivariate cluster analysis. The resulting compositional map (bottom) reveals natural nanoscale Melanin inclusions (grey and black) in the cortex region (light yellow) *in situ* for the first time, moving closer toward complete impact evaluation of drugs and treatment procedures.



I. Amenabar et al.,
Nature Comm.
2017, 8, 14402.

nano-FTIR HSI assesses the impact of cosmetic treatment on the hair chemical structure

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.



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