Professor Alexandre Dazzi, Université Paris-Sud
Infrared nanoscopy applied to advanced life science

nanoIR spectroscopy allows analysis of the production optimization of bio-polymer (Poly-HydroxyButyrate) done by a photosynthetic bacteria, *Rhodobacter sphaeroides*. PHB vesicles inside the bacterium are easily detected due to its specific absorption band (ester carbonyl at 1740 cm\(^{-1}\)) that is different from those of the bacterium. Similar studies are also provided on different bacteria like *Streptomyces* to optimize the production of bio-fuel precursor (triacylglycerols).

Associate Professor Tue Hassenkam, University of Copenhagen
Remains of 3.7 billion year old life trapped in mineral inclusions

Metasedimentary rocks from Isua, West Greenland (>3.7 billion years old) contain depleted carbonaceous compounds, with isotopic ratios consistent with a biogenic origin. Carbonaceous inclusions armoured within garnet porphyroblasts were analyzed *in-situ* with nanoscale IR spectroscopy. The results are consistent with biogenic organic material isolated for billions of years. They therefore provide spatial characterization for potentially the oldest biogenic carbon relics in Earth’s geologic record.

Dr. Suzanne Morsch, University of Manchester
AFM-IR insights into epoxy resin nanostructures

The disputed nodular morphology found within epoxy resins corresponds to chemical heterogeneity associated with an inhomogeneous cure, and that this may be controlled by factors such as overall cross-linking density, catalytic selectivity and resin stoichiometry. These heterogeneous nanostructures are proposed to result in the establishment of transport pathways through resin materials, a key stage in degradation. It has also been found that exposure to water leads to the development of a porous morphology in epoxy-phenolic coatings, and in-situ AFM-IR experiments under humid conditions have shown that moisture sorption is concentrated within these pores.

Dr. Francesco Simone Ruggeri, University of Cambridge
Nanoscale IR spectroscopy: A new emerging tool to investigate proteins misfolding and aggregation

nanoIR spectroscopy has shown to be a versatile tool to characterize at the nanoscale the conformational rearrangements of proteins during their aggregation at the single molecule scale. These findings are central to design molecules that could interfere with amyloid aggregation delaying the onset of misfolding diseases.

Dr. Zoran Ristanović, Utrecht University
Infrared nanoscopy insights into assembly and growth of ultra-thin metal-organic framework films

Control over the assembly, orientation, and defect-free growth of metal-organic framework (MOF) films is crucial for their future applications. A liquid-phase epitaxy is considered a suitable method to synthesize highly oriented films of numerous surface-attached MOF topologies, but the initial stages of the film growth remain poorly understood. AFM-IR is used to provide spectroscopic signatures for the highly diverse and defect-rich metal-organic chemistry in the MOF films. Based on these mechanistic and spectroscopic insights, it is now possible to produce highly oriented MOF films with significantly shorter synthesis times.
Dr. Miriam Unger, Anasys Instruments
Latest advancements in nanoscale IR spectroscopy: Spatial resolution, speed and spectral range
The new Resonance Enhanced AFM-IR technology has demonstrated 100x faster spectral and 10X faster imaging acquisition times with better SNR. This development helps augment the reliability of nanoscale characterization by reducing the overall data acquisition time and enabling users to perform repeated measurements for statistical analysis. In addition, new nano FTIR capability allows measurements in the C-H, N-H and O-H vibrational stretching range (3600-2700 cm⁻¹) with significantly improved sensitivity.

Anna Borkowska, Institute of Nuclear Physics PAN
Single chromosome nanospectroscopic studies using nanoscale IR spectroscopy
Human chromosomes are objects of interest of biochemical and biophysical studies because of its high biological relevance. They are composed of chromatin, which is a mixture of nucleic acids (DNA) and proteins (histones). nanoIR spectroscopy gives unique insight into chromosome structure because it enables simultaneous studies of AFM topography with IR measurements of chemical composition of measured item. This case study specifically addresses the comparison of OPO and QCL lasers on the nanoIR2 system.

Francesca Cavezza, Vrije Universiteit Brussel
Probing chemical interactions between organic conversion coatings and aluminium oxide with high lateral resolution
Industrial organic conversion coatings contain a wide mixture of different monomer compounds. In this work, acrylic monomers, phosphonic monomers and a mixture of the two, in different ratio, were deposited on a pre-treated aluminium alloy. By comparing AFM-IR spectra from the bare aluminium oxide and the monomer-coated aluminium oxide, it is possible to pinpoint the interfacial interactions of the substrate. The ability to locally probe the interaction between the organic coating and the aluminium oxide, without the need of vacuum surface sensitive techniques, increases the understanding, and hence the tuneability, of the organic coating and aluminium-oxide interface.

Timur Shaykhutdinov, Leibniz-Institut für Analytische Wissenschaften - ISAS - e.V.
Polarization-dependent AFM-IR: The IR nanopolarimetric approach
This presentation will highlight applications of the AFM-IR method, including anisotropic growth mechanisms of supramolecular aggregates, oriented protein aggregation upon adsorption, local and propagating modes in thin inorganic films, and anisotropic absorption in polymer films. The analysis of the nanoscale anisotropy is supported by vibrational (DFT) and electrodynamic (FDTD) calculations.

Jehan Waeytans, Université Libre de Bruxelles
Polymer characterisation by nanoscale infrared spectroscopy
Model samples made of polystyrene thin films, as well as commercial multilayer packaging films have been characterised by AFM-IR. Infrared spectra with sufficient signal-to-noise ratio (S/N) were recorded in a single scan for thicknesses down to 16 nm. AFM-IR is particularly powerful for multilayer samples, and it was possible to identify the chemical nature of each layer in the commercial sample, as well as the typical interfacial thickness between each layer. A value of 600 nm was determined, which would have been inaccessible by conventional IR microscopy.
Associate Professor Czesława Paluszkiewicz, Institute of Nuclear Physics PAN
Latest advancements in nanoscale IR spectroscopy: Spatial resolution, speed and spectral range
The human eyes are affected by many disease- and age-related changes. One of the most common is a cataract which causes lens clouding, mainly observed in the crystalline lens. The current data showed that the protein aggregation and changes in lipid composition are responsible for the cataract formation. The obtained results indicate the usefulness of the nanoIR2 for investigations of tissues structural changes due to the disease development. The performed analysis provide characterization of protein secondary structure variations during degradation.

Natalia Piergies, Institute of Nuclear Physics PAN
Single chromosome nanospectroscopic studies using nanoscale IR spectroscopy
Breast cancer is one of the most common disease which affects women. Transformation of the normal cell to the malignant one is still not fully understood. In order to get closer understanding this disease, nanoIR spectroscopy was used to analyze the differences between human breast cancer cell lines and normal cells. Spectra of cancer cells showed higher intensities of lipid and DNA bands comparing to the normal ones. The application of these methods which provide vibrational characterization of the investigated materials supply more unambiguous identification of structural variations due to the cells transformation from normal to tumor ones.