Unravelling Molecular Structure and Interactions with Single Molecule Nanochemical Imaging and Spectroscopy

Wednesday, April 6th, 2022 | 1:00 PM BST | 14:00 CEST

Join us and our special guest speaker **Dr Francesco Simone Ruggeri from Wageningen University, Netherlands**, for a talk on unravelling molecular structures and interactions with single molecule nanochemical imaging and spectroscopy.

By combining infrared spectroscopy with atomic force microscopy-based (AFM-IR), it is possible to perform chemical analysis and compositional mapping with a spatial resolution down to 10 nm.

Dr Ruggeri, a pioneer in this field of science, has pushed the boundaries of modern microscopy and spectroscopy to study biomolecular processes and functional materials. He has demonstrated that infrared nanospectroscopy can be used to determine the chemical fingerprint and secondary structure of biological samples and materials in native liquid environments and, for the first time, down to the single biomolecule scale. His approach has led to new insights into the formation and structural characterization of the misfolding of proteins and their correlation with the onset of neurodegenerative disorders, and, by taking inspiration from nature, the production of new, sustainable substitutes for pollution causing plastics.

Don’t miss this opportunity to hear him speak live about his work.

Program – Wednesday, April 6th, 2022 | 1:00 PM BST | 14:00 CEST

14:00 **Welcome & Introduction**
Dr Miriam Unger, Applications Manager EMEA, NanoIR, Bruker Nano GmbH

14:10 **Single Molecule Nanochemical Imaging and Spectroscopy: Unravelling Molecular Structure and Interactions**
Dr Francesco Simone Ruggeri, Wageningen University,Netherlands

14:40 **Q&A**

14:50 **Closing**

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

Abstract and Biography

The development and application of photothermal infrared absorption nanospectroscopy (AFM-IR) was a real breakthrough for the analysis of heterogeneous (bio)-molecular systems and their interactions, from the single molecule scale up to living organisms. As a major advance in the field, we have demonstrated the achievement of detecting single protein molecules by introducing off-resonance, low power and short pulse infrared nanospectroscopy (ORS-nanoIR). By pushing the sensitivity of AFM-IR to its current limit, we have proven that the secondary structure of single protein molecules can be determined with an accuracy similar to that obtained in bulk by IR spectroscopy (**Nature Comm**., 2020). Our approach further enables the unravelling of the secondary structure (**Advanced Science**, 2021) and molecular interaction fingerprint of the amyloid species involved in the onset of neurodegenerative disorders (**Nature Comm**., 2021). We study the interaction of these supramolecular assemblies with an organic FDA approved drug capable of preventing the disease in animal models of neurodegeneration. Furthermore, we have demonstrated the application of this unprecedented sensitivity to unravel the properties of organic and bio-organic functional materials. We have also demonstrated that, using AFM-IR, it is possible to study the chemical heterogeneity of artificial model membranes (**Advance Functional Materials**, 2021) and perovskites (**Science**, 2021). AFM-IR can also be used to unravel the structure of the functional protein assemblies that occur functionally in nature (**Small Methods**, 2021) and that are promising candidates for the development of a novel class of biocompatible and sustainable biomaterials (**Nature Nanotechnology**, 2020). This talk will also cover our goal to expand the capabilities of nanoscale vibrational spectroscopy to shed light on the structure-activity relationship of biomolecules for applications in nano-medicine, materials science and biotechnology.

Francesco Simone Ruggeri is currently Assistant Professor at Wageningen University, Netherlands. Before his appointment at Wageningen, he was an independent Junior Research Fellow at the Department of Chemistry at the University of Cambridge and at the Darwin College, UK. He holds a PhD in Biophysics obtained in 2015 at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland.

Dr Ruggeri has led the development and application of single-molecule scanning probe microscopy and spectroscopic methods for the characterisation of biomolecular processes and (bio-)materials at the nanoscale. He has developed and applied single molecule AFM-based approaches, in combination with microfluidics, to study the chemical and structural properties of (bio)molecular systems that are challenging to access using conventional bulk methods. Furthermore, he was the first to demonstrate the application of nanomechanical mapping and infrared nanospectroscopy (AFM-IR) to unravel the properties of these (bio-)molecular systems at the nanoscale and acquire their chemical fingerprint and secondary structure in native liquid environments and at the single-molecule scale.

Dr Ruggeri's expertise has, to date, led to the publication of over 65 peer-reviewed scientific articles, of which over half as first or corresponding author, and over 20 of these papers are in Nature series journals, Science, PNAS, Angewandte, and ACS Nano.