Label-Free Imaging to Characterize New Antibiotics Carriers by IR Nanospectroscopy

J. Mathurin*, E. Pancani, A. Deniset-Besseau, R. Gref, A. Dazzi

* Laboratoire de Chimie Physique, Université Paris-Sud,
15 Rue Georges Clemenceau91405 Orsay - France
e-mail: jeremie.mathurin@u-psud.fr

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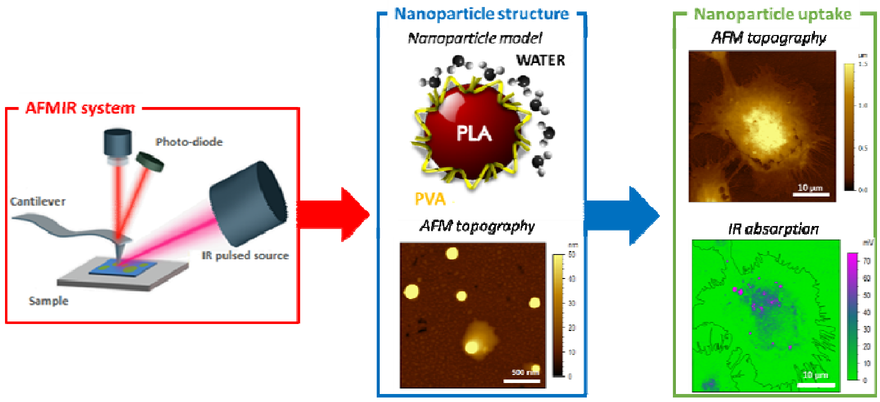
With the increase of antibiotic resistance significant effort is focused on research towards higher efficiency and better selectivity solutions. However, the side effects of high efficacy antibiotics can influence the general condition of patients, therefore using first generation compounds with nanoparticlesas delivery vehicles may be a good solution to specifically target bacteria with higher doses of antibiotics. For such developments it is mandatory to understand the structure and internal chemistry of nanoparticle/antibiotic systems.To this end the most effective studies should involve label-free techniques capable of sub-micrometer spatial resolution**.**

AFM-IR microscopy is a well-established technique first demonstrated in 2005 combining the spatial resolution of an AFM microscope and a tunable IR sources to reach optical resolutions smaller than the far field diffraction limit by measuring molecular expansion [1]. Recent developments focusing on resonant excitation of the AFM cantilever (Resonance Enhanced AFM-IR or RE-AFM-IR) by a tunable pulsed source led to significant increase in sensitivity and spatial resolution up to 10 nm [2].

We will discussthe possibilities to apply RE-AFM-IR as a label free technique for the study of polymeric nanoparticles. In the first part, we will show how the method can be used to reveal new insight about the structure of polymeric nanoparticles compared withlow resolution methods. In the second part, we will demonstrate the use of RE-AFM-IR as a new tool to follow the localization of nanoparticles inside fixed macrophages at the subcellular scale.



From left to right: Principle of the technique- Polymeric nanoparticle (NPs): theoretical scheme and topographic image- IR nanospectroscopy of Nps within macrophage: topographic image and chemical map.

References

[1] A. Dazzi, R. Prazeres, F. Glotin, J. M. Ortega, “Local infrared microspectroscopy with subwavelength spatial resolution with an atomic force microscope tip used as a photothermal sensor”, Opt. Lett.30, Issue 18, 2388-2390 (2005).

[2] F. Lu, M. Jin, M. A. Belkin, “Tip-enhanced infrared nanospectroscopy via molecular expansion force detection”, Nat. Photon. 8, 307–312 (2014).