Tomographic and chemical analysis of the lipid vesicles inside bacteria for biofuel production by a new multi-frequency UA-AFM-IR platform

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We have developed a new AFM-based platform combining IR spectroscopy and acoustic and/or microwave 3D tomography (1-2) to detect and characterize lipidic vesicles present in the cytoplasm of various micro-organisms. We started with the bacteria *Streptomyces* that is able to store excess of carbon as TriAcylGlycerols (TAGs) in lipid vesicles. TAG are a ready-to-use source of bio-diesel, chemically and structurally identical to those found in commercial fuels. To illustrate the potential of these techniques, we will present the detection and size distribution (accuracy under 10 nm) of triglycerides vesicles in *Streptomyces* using high-resolution infrared microscopy AFM-IR (3) as well as acoustic wave in ultrasound mode UA-AFM (4). We extended the excitation range to microwave (range up to 16 GHz), and achieved a comparative study of AFM-IR, acoustic, and microwave scanning analysis. Our results indicate that the coupling of these techniques constitutes a great advantage to fully characterize chemical, topographical and volumetric parameters of a biological sample. We will present a 3D reconstruction of bacteria or yeast cells, showing the in-depth vesicles distribution. Similar analysis will be carried out with oleaginous (*Yarrovia lipolytica*) and non-oleaginous yeasts (*Saccharomyces cerevisiae* yeasts) as well as with *Listeria* in order to demonstrate the great potential of acoustic and microwave microscopy.

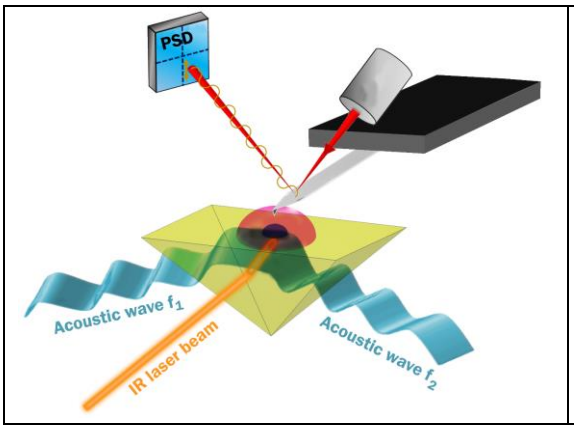


Fig. 1 - MS-AFM-IR platform

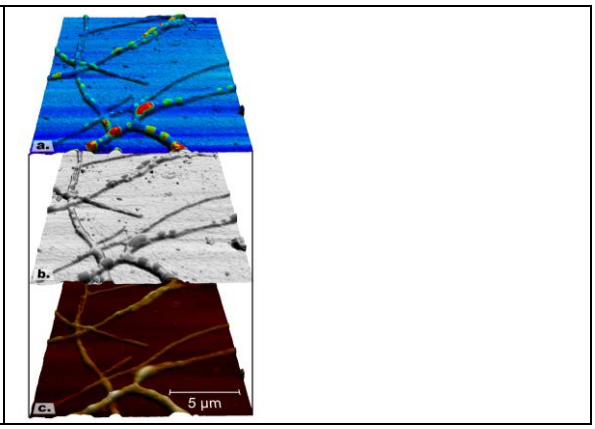


Fig. 2 – From top to bottom: AFM-IR at 1740 cm^{-1}, UA-AFM at 640kHz, and AFM image (Range 10 µm)

References

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