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Title : Microwave dielectric spectroscopy as an analytic technique of electroporated cells

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Microwave dielectric spectroscopy is under development for decades. It consists in characterizing whether solid, liquid or gaseous materials with their dielectric properties in this specific frequency range. The technique is intrinsically non-destructive, rapid and without requiring a direct contact with the sample under test, which made it particularly attractive for its exploitation in many applicative domains, such as the detection of pipeline in the soil, coal in canalizations, as well as moisture sensing in agriculture areas, wood industry or for food quality assessments (1)-(3). However, based on cumbersome microwave equipment, microwave dielectric spectroscopy has been for long limited to macroscale developments.

With the advent of the micro and nanotechnologies, new applicative opportunities have opened up in chemistry, biology and medicine notably. Due to the resonant frequency of the water molecules in the microwave band, the technique is particularly sensitive to biological materials, which naturally exhibit a high-water content. Combined with the use and the manipulation of small liquid volumes, this sensing technique has been successfully developed for molecular and cellular analysis (4)-(5). The technique has been applied to tissues, cells suspensions and down to individual cells analysis. It was also demonstrated for cell quantification, identification and the monitoring of biological processes, while cells were maintained in their traditional environment, their culture medium. Attractively for cellular investigations, the sensing technique is also non-invasive and label free. And more interestingly, due to the employed high frequency range, the electromagnetic fields may bypass the capacitive cytoplasmic membrane and penetrate inside the cells, revealing quantitative information related to the intracellular dielectric activity. This spectroscopic method consequently appears suitable to analyze internal variations of cells, which notably involve water molecules interaction modifications.

To verify such an ability, different physical or chemical stimuli applied on various cell lines have been investigated. Among them is the application of millisecond pulsed electric fields at different intensity levels on cell suspensions. Impact of such fields on the dielectric responses will be presented at the single cell level, highlighting the characterization possibility of the microwave dielectric spectroscopy compare to a traditional gold standard technique.

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