Applications of ATR-FTIR spectroscopy for the in-situ study of early stages of biofilm formation: spectroscopic characterization and monitoring

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The Attenuated Total Reflectance - Fourier Transform InfraRed (ATR-FTIR) spectroscopy has been very early applied for studying biofilms, *in situ*, nondestructively, in real time, and under fully hydrated conditions [1]. Because its analysis depth is very thin, typically of the order of 1-2 µm, the ATR-FTIR technique is an interesting tool for monitoring *in situ* not only initial stages of biofilm formation but also subsequently response of the base sessile bacteria monolayer to environmental condition changes and for studying the influence of environmental conditions on bacterial adhesion, biofilm growth or detachment processes [2-3]. For example, the time evolution of the bands assigned mainly to proteins, nucleic acids, and polysaccharides allows for conveniently monitoring biomass accumulation on the ATR crystal, whereas the detailed analysis of the whole spectral profile may provide information about biochemical and structural changes accompanying bacterial adhesion, biofilm development, detachment processes and environmental condition changes (temperature, hydration rate, nutrient quality and quantity, biocide addition, …). A more detailed knowledge of nascent biofilm ATR-FTIR fingerprints combined with monitoring capability should enable in the future to consider various applications such as, for example, *in-situ* assessment of water biostability in various water systems. This talk will present an overview of the uses of ATR-FTIR in this field and be illustrated with some of our last findings about *Pseudomonas fluorescens* bacteria. The basis, the potential, and the current limitations of theses approaches as well as future directions will be discussed.

References:

[1] Bremer P.J. and Geesey G.G.. An evaluation of biofilm development utilizing non-destructive attenuated total reflectance Fourier transform infrared spectroscopy. *Biofouling* 3, 89-100 (1991).

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