PhD Research Project

Influence of environmental stresses on the physicochemical properties of young biofilms: Combining Infrared and Raman vibrational spectroscopy with AFM force spectroscopy

Institution: Henri Poincaré University of Nancy, France

Laboratory: Laboratory of Physical Chemistry and Microbiology for the Environment (LCPME) UMR 7564 - 405, rue de Vandoeuvre – 54600 Villers-lès-Nancy, France

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Application deadline: 29 April 2011

Biofilms are complex communities of microorganisms embedded in a self-secreted matrix of extracellular polymeric substances (EPS). They occur on the surface of most materials and are causing significant economic and health problems in a wide range of environmental, industrial and medical areas. Preventing, or at least controlling biofilm formation requires a better knowledge of the physicochemical contributions governing the interactions of these microorganisms with their surroundings especially during the initial stages of biofilm formation. Given the complexity of these systems, a macroscopic approach can not be sufficient. Physicochemical properties have to be characterized locally at a cellular and molecular level and, if possible, *in situ* and in real time to also access dynamic processes involved.

This thesis will aim to probe *in situ*, at the cellular and molecular scales, mechanical and physicochemical properties (elasticity, adhesion strength, hydrophobicity) of sessile and planktonic bacterial cells and to analyze their evolution during the early stages of biofilm formation and under different environmental stresses (hydrodynamics, water, nutrition, presence of biocides, ...). The chemical composition of the organic interphase lying between the cytoplasm of the cell and its external environment will be characterized, and special attention will be focussed on the conformational properties of exopolymers secreted by the bacteria. To achieve these objectives, the thesis will rely on the expertise of our group in the field of vibrational spectroscopy -even near field spectroscopy- and atomic force microscopy (AFM). Four techniques will be combined and associated with conventional techniques of microbiology: infrared spectroscopy in ATR mode, confocal Raman spectroscopy, epifluorescence microscopy and AFM force spectroscopy.

Candidate Profil

The candidate should hold a very good master's or equivalent degree in physical chemistry, in chemistry or in biophysics and be motivated to tackle challenging research problems. Competences in AFM or/and vibrational spectroscopy will be appreciated and knowledge of microbiology would be an advantage.

To apply, candidates should submit a detailed CV, transcripts of undergraduate grades, motivation letter to Prof. F. Humbert (francois.humbert@lcpme.cnrs-nancy.fr).

Funding availability

This 3-year research project is in competition for funding with 16 projects at this institution. Usually the projects (7 or 8) which receive the best applicants will be awarded the funding. Applications for this project are welcome from suitably qualified candidates worldwide

References

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Francius G, Alsteens D, Dupres V, Lebeer S, De Keersmaecker S, et al. (2009) Stretching polysaccharides on live cells using single molecule force spectroscopy. Nature Protocols 4: 939-946.

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