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Gregory Francius, Laurence Mathieu, J.-C Block

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AFM assessment of organic conditioning film on surfaces exposed to drinking water

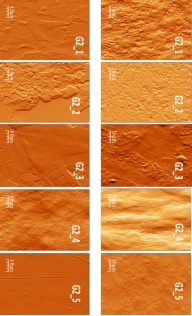
G. Francius, L. Mathieu and J.-C. Block

Université de Lorraine, CNRS, and EPHE – Laboratory LCPME, UMR 7564, 405-rue de Vandoeuvre, F-54506 Villers-lès-Nancy
gregory.francius@uni-lorraine.fr

Background and objectives

Biofouling of any material in contact with water should begin with the attachment of a set of organic biopolymers recruited from the bulk water and forming a so-called « conditioning film ». The conditioning biofilm is generally considered as a critical factor in biofilm initiation. However, the preliminary steps in conditioning biofilm development under conditions relevant to drinking water distribution are clearly under-explored and only few studies have attempted to characterize this tiny organic deposit.

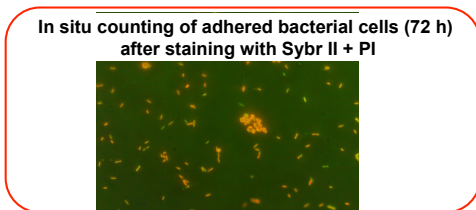
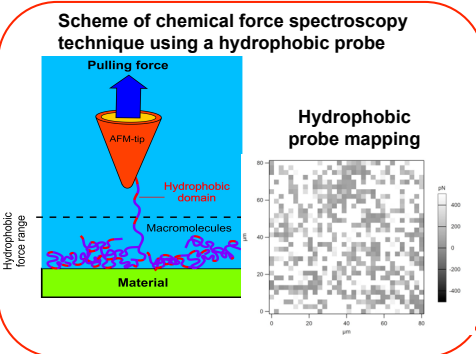
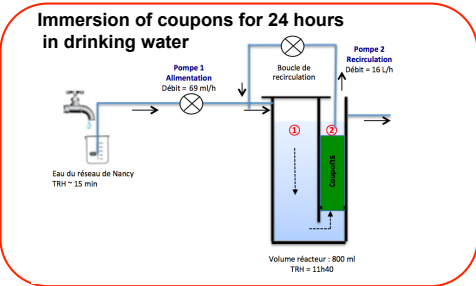
Here we describe AFM characterization of organic biopolymers and bacteria accumulated on polymeric materials after immersion in tap water for short period of time (24 h, 20°C) under low turbulent hydrodynamic conditions. Our study aims to assess the nature and distribution of the macromolecules of the conditioning film according to the physicochemical characteristics of the tested materials.



12 polymeric materials tested in the study

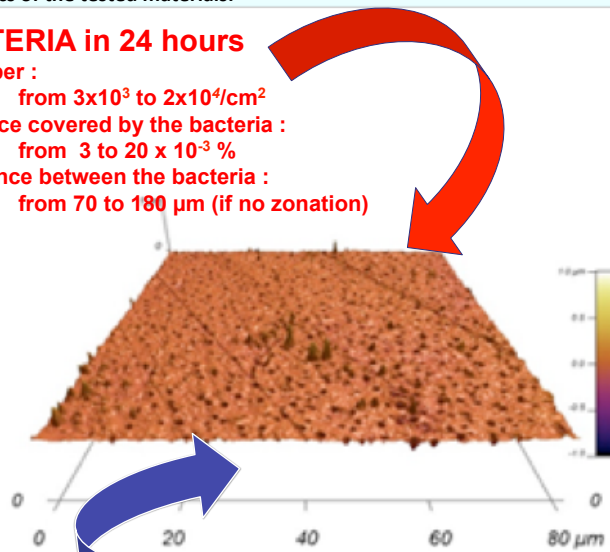
Roughness from 0.2 to 2,450 nm

Hydrophobicity forces from 0.2 to 17nN



BACTERIA in 24 hours

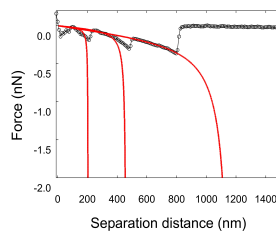
- Number : from 3×10^3 to 2×10^4 / cm^2
- Surface covered by the bacteria : from 3 to 20×10^{-3} %
- Distance between the bacteria : from 70 to 180 μm (if no zonation)



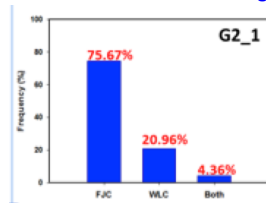
POLYMERS in 24 hours

Polymers from 1 to 1×10^6 / cm^2
Lc from 50 to 500 nm

POLYMER CHARACTERIZATION



WJC and FJC modeling



- * Surface covered by polymers: 16×10^{-3} %
- * Assuming a spherical polymer particle should be in the range of 50 nm in diameter (Francius *et al.* 2014 J. Bionanoscience)

Distance between polymer particles from 3 to 8 μm (if no zonation)

Preliminary conclusions

- Attachment of organic polymers is very rapid (much more rapid than bacteria cell attachment)
- More than 1×10^6 polymers / cm^2
- Polymers could be dominated by glycoproteins
- According to the distance between polymer particles and bacteria on the surface, the data do not prove the organic polymers on the surface (so called « conditioning biofilm ») interfere (positively nor negatively) with bacteria adhesion

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