Effect of topography on surface colonization by *Pseudomonas aeruginosa*

Contact : Mathieu Letrou / mathieu.letrou@univ-grenoble-alpes.fr

Location : Laboratoire Interdisciplinaire de Physique (LIPhy), 140 rue de la Physique, 38400 Saint-Martin d'Hères, France.

The MC2 team at LIPhy conducts interdisciplinary research at the interface of mechanics, physics, and life sciences, using experimental and theoretical approaches at different scales. The aim of this project is to use a microfluidic platform developed within the team to study surface contamination by an opportunistic pathogen (*Pseudomonas aeruginosa*).

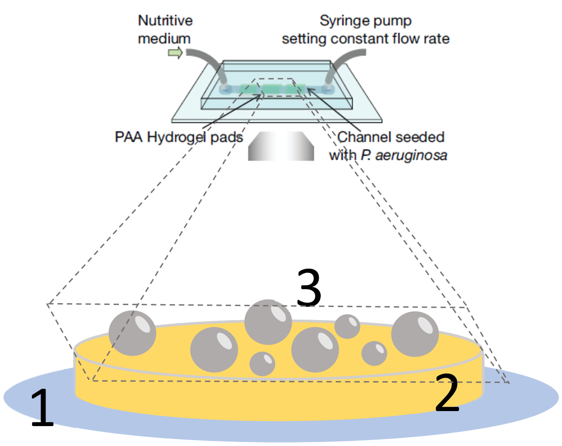

Figure 1 : Schematic of the platform composed of 3 layers: (1) glass coverslip (2) PAA hydrogel (3) covalently bound polystyrene microbeads

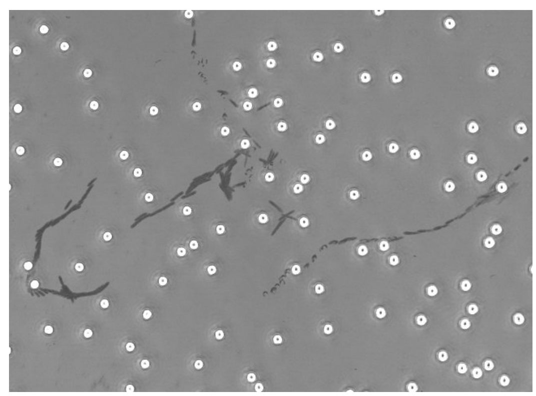

Figure 2 : 60 min tracks of Pseudomonas Aeruginosa on 70 kPa PAA substrate with 2µm beads

When colonizing surfaces, these bacteria can form collective structures called biofilms. These biofilms play a central role in their survival: they offer protection against physical and chemical stresses and facilitate the exchange of genetic information between strains. Current experimental protocols are mainly based on smooth artificial surfaces, which provide good control over experimental conditions. However, real contaminated surfaces are rough, which limits the representativeness of existing models.

To simulate real-life conditions, our team has developed a platform that allows us to simultaneously control chemistry, rigidity, and surface topography (see Figure 1). In this project, we aim to understand the interaction of a bacterium (*Pseudomonas aeruginosa*) exhibiting "twitching" motility with obstacles of different sizes and at different concentrations on a surface. First, we will characterize the surface and model the interaction of an individual bacterium with an obstacle under fixed experimental conditions, and then attempt to link this to the observed collective phenotype. In a second step, we will examine the consequences of these interactions on the mixture of strains, the expression of extracellular matrix, the use of other pathogens, and variations in the physicochemical properties of the surface.

Expected skills :

This project is mainly experimental and will be carried out in collaboration with a postdoctoral researcher. The specific focus of the work can be discussed based on the intern's interests. Sample preparation requires rigor, attention to detail, and patience. Previous experience in coding (Python), image analysis (ImageJ), bacterial culture, or AFM microscopy would be appreciated but is not required.

Related references :

Yow-Ren Chang, Eric R. Weeks, and William A. Ducker, “Surface Topography Hinders Bacterial Surface Motility”, *ACS Applied Materials & Interfaces* (2018)

Sofia Gomez, Lionel Bureau, Karin John, Elise-Noëlle Chêne, Delphine Débarre, Sigolene Lecuyer, "Substrate stiffness impacts early biofilm formation by modulating Pseudomonas aeruginosa twitching motility", *eLife* (2023)

Mathieu Letrou, Kennedy Chaga Encarnacion, Rebecca Mathias, Yeraldinne Carrasco Salas, Sofia Gomez Ho, Elena Murillo Vilella, Lionel Bureau, Sigolène Lecuyer, Delphine Débarre “Bacterial exploration of solid/liquid interfaces: developing platforms to control the physico-chemical microenvironment”, *EPJE* (preprint, 2025)