Project 3.16. Physical chemistry of bacteria-surface interactions

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ICP PAS Group: Dioscuri Centre for Physics and Chemistry of Bacteria

www: https://dioscuricentrebacteria.com/

Background:

The Dioscuri Centre for the Physics and Chemistry of Bacteria invites applications for a PhD position in the physical chemistry of bacteria-surface interactions.

Many bacteria are able to form biofilms – colonies of cells attached to a surface submerged in a liquid [1]. In many (though not all) cases biofilm formation is not desired. Examples include dental plaque, biofilms in sewage pipes, on ships' hulls, and on medical catheters. Despite significant resources invested world-wide to develop novel ways of controlling biofilm formation and growth, preventing these processes remains challenging.

Physical and chemical interactions responsible for surface attachment of bacteria are now much better understood than a decade ago [2]. However, it remains unclear how these interactions affect the growth of bacterial colonies beyond the initial attachment. Factors such as friction and adhesion are known to be important [3-4], but a detailed knowledge of the mechanism of these interactions is lacking. In particular, it would be interesting to know if these interactions could be disturbed by simple, industry-scalable physical or chemical means to limit bacterial growth.

References
[1] Costerton, J. W., Stewart, P. S. & Greenberg, E. P., Science 284, 1318–1322 (1999).
[2] Persat, A. et al., Cell 161, 988–997 (2015).
[3] Gralka, M. et al., Ecol Lett 19, 889–898 (2016).
[4] Farrell, F. D., Gralka, M., Hallatschek, O. & Waclaw, B., RS Interface 14, 20170073 (2017).

Aim:

You will investigate how different modifications of cell-surface and cell-cell interactions by chemical (surfactants, small-molecule inhibitors of surface adhesins) and physical means (micro-patterned surfaces, vibrating surfaces) affect bacterial colonies growing on solid surfaces. To do this, you will incubate bacteria in a microfluidic device, image their colonies in real time using optical microscopy, and characterize colony morphology (size, shape, etc.) and its growth rate for different treatments outlined above.

Requirements:

- Msc in physics, chemistry, biology or engineering. Very good English. Strong interest in performing experiments and interpreting them in the context of existing theoretical models. Very good academic achievements and a strong motivation to learn the required biology. Desired: previous experience with surface physics/chemistry, ability to work with people from diverse background.

- This project may also be interesting to candidates who would like to combine experiments and computer modelling. Strong candidates with theory background but little- or no lab experience will also be considered if they are happy to switch to experiment-driven research.
- The candidate is expected to work closely with other experimentalists and modellers from the Dioscuri Centre and the Soft Condensed Matter group (Prof. R. Hołyst), and with theorists from the Department of Evolutionary Theory in MPI in Ploen, Germany. The project may involve regular visits to Ploen (a few weeks/year), participation in national and international conferences, and internal seminars/group discussions.
- In addition to submitting the application to the Warsaw4PhD doctoral school, candidates must submit a separate application for a position in the Dioscuri Centre. Further information on how to do this will be available on https://dioscuricentrebacteria.com/jobs/