MPIDS Colloquium

MAX-PLANCK-GESELLSCHAFT

The physico-chemistry of irreversible bacterial adhesion as an important step to biofilm formation

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Bacterial approach and deposition is the first step in biofilm formation, and is often characterized and explained by macroscopic thermodynamic theories based on the extended DLVO-theory, that describes adhesion in similar terms as in colloidal stability and flocculation. The second stage of bacterial adhesion comprises the maturation of the bond, that is characterized by increasing numbers of attached molecules. Based on experimental results using Brownian motion of sessile bacteria and AFM force-distance measurements we could establish that this second stage of bacterial adhesion can be considered as an irreversible adhesion to surfaces through multiple, reversibly-binding tethers as described by polymer adsorption theories. These tethers detach and successively re-attach, but not collectively detach to cause detachment of an entire bacterium. The establishment of tether binding may lead to compression of the EPS layer and deformation of the cell membrane as we observed by using Surface Enhanced Fluorescence imaging. Extensive deformation has impact on the exchange of ions between the bacterial cell and the environment and may trigger biofilm formation or (if adhesion forces are too large) eventually lead to a lethal state.

Wednesday, May 02nd, 2018 at 2:15 pm

MPIDS, Prandtl lecture hall, building AI, Am Faßberg 11, Göttingen

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