Abstract:

Bacteria can adjust the structure of colonies and biofilms to enhance their survival rate under external stress. Very little is known about the link between physical interaction forces and the structure of colonies and biofilms. We have generated a molecular toolbox based on type IV pili that allow tuning the interaction force between bacteria systematically. Using laser tweezers, we show that different post-translational modifications of the major pilin subunit of *Neisseria gonorrhoeae* affect the binding strength between bacteria bound to each other by type IV pili. Moreover, we generated strains in which pilus motor activity can be tuned by titrating non-functional PilT motor proteins. Using this toolbox, we address the question how differential interaction forces govern cell sorting, and the structure and dynamics of microcolonies. By detecting the position of each individual cell in the colony, we show that the activity of type IV pilus motors accelerates local fluid-like ordering. At a larger scale, the colony dynamics shows fluid-like behavior whereby both motor activity and pilin post-translational modification strongly affect the viscosity. When bacteria generating pili with different post-translational modifications are mixed, the variant with the smallest interaction force sorts to the surface of the colony. These 'materials' properties strongly impact on bacterial fitness; e.g. surface dwelling cells experience best access to space and nutrients.