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Films of Bacteria at Interfaces

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Abstract

Bacteria are often discussed as active colloids, self-propelled organisms whose collective motion can be studied in the context of non-equilibrium statistical mechanics. In such studies, the behavior of bacteria confined to interfaces or in the proximity of an interface plays an important role. For instance, many studies have probed collective behavior of bacteria in quasi two-dimensional systems such as soap films. Since fluid interfaces can adsorb surfactants and other materials, the stress and velocity boundary conditions at interfaces can alter bacteria motion; hydrodynamic studies of interfaces with differing boundary conditions are reviewed. Also, bacteria in bulk can become trapped at or near fluid interfaces, where they colonize and form structures comprising secretions like exopolysaccharides, surfactants, living and dead bacteria, thereby creating Films of Bacteria at Interfaces (FBI). The formation of FBI is discussed at air-water, oil-water, and water-water interfaces, with an emphasis on film mechanics, and with some allusion to genetic functions guiding bacteria to restructure fluid interfaces. At air-water interfaces, bacteria form pellicles or interfacial biofilms. Studies are reviewed that reveal that pellicle material properties differ for different strains of bacteria, and that pellicle physicochemistry can act as a feedback mechanism to regulate film formation. At oil-water interfaces, a range of FBI form, depending on bacteria strain. Some bacteria-laden

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