

Switchable and Adaptive Bioadhesion - Insights from Living Systems

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Among all living species, microbes are the most abundant and diverse form of life on Earth. They have conquered almost all ecosystems of our planet by successfully adapting to their environment. Life on Earth has evolved under the exposure of sunlight and many species are equipped with a photosynthesis machinery enabling them to transform light into chemical energy. Their microhabitats include liquid-infused soil, porous rocks and microdroplets, featuring complex geometric architectures that support strong spatial and temporal fluctuations of light exposure. Thus, developing functionalities to rapidly respond to light fluctuations, far more than other environmental cues, has been pivotal for natural selection.

In this presentation, I will show how experimental methods from soft matter physics and biophysics [1], in conjunction with theoretical concepts from non-equilibrium statistical physics, enable us to decipher fundamental physical principles of the light response of photosynthetic microorganisms. In particular, I will focus on the interactions of light-sensing microbes with abiotic surfaces [2] and discuss in detail, how the bioadhesion of living microbes can be highly adaptive [3,4] and even reversibly switchable within seconds [5] .

[1] M. Backholm and O. Bäumchen, Nature Protocols 14, 594 (2019); [2] S. Till et al., Physical Review Research, accepted (2022); [3] C.T. Kreis et al., Soft Matter 15, 3027 (2019); [4] N. Xu et al., eLife 9, e58805 (2020); [5] C.T. Kreis et al., Nature Physics 14, 45 (2018).

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