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The Design and Characterization of Artifical Biofilms: Microbial Catalyst Platforms Based on Photo-Autotrophic Syntrophy

Biofilm cells exist in environments with much higher local cell densities than those found in liquid environments, leading to significantly elevated levels of localized metabolic by-products. Such metabolites have the potential to play a key role in heterogeneous biofilms via syntrophy, a mutually beneficial process in which one microbe utilizes the by-products of another for its own proliferation. This project examined the metabolic characteristics of a microbial consortia biofilm comprised of two organisms. These artificial communities utilized an autotrophic cyanobacteria, *Synechococcus sp*., as a primary producer and a heterotrophic *Escherichia coli* as the corresponding consumer strain. Benefits of syntrophic metabolite exchange were characterized through growth rate data, vitamin exchanges, and comparison of biomass productivity under applied conditions. The artificial binary biofilm cultures displayed an approximate 40% increase in biomass productivity and nearly a 1.5-log increase in colony forming units per biofilm over the control *Synechococcus* mono-cultures. Current work on this system seeks to better understand the role of oxygen production and scavenging between the *Synechococcus* and *E. coli* as well as species-dependent spatial portioning within the biofilm.