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Biologically fabricated materials from engineered microbes

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Abstract

The intersection between synthetic biology and materials science is an underexplored area with great potential to positively affect our daily lives, with applications ranging from manufacturing to medicine. My group is interested in harnessing the biosynthetic potential of microbes, not only as factories for the production of raw materials, but as fabrication plants that can orchestrate the assembly of complex functional materials. We call this approach “biologically fabricated materials”, a process whose goal is to genetically program microbes to assemble materials from biomolecular building blocks without the need for time consuming and expensive purification protocols or specialized equipment. Accordingly, we have developed Biofilm Integrated Nanofiber Display (BIND), which relies on the biologically directed assembly of biofilm matrix proteins of the curli system in *E. coli*. We demonstrate that bacterial cells can be programmed to synthesize a range of functional materials with straightforward genetic engineering techniques. The resulting materials are highly customizable and easy to fabricate, and we are investigating their use for practical uses ranging from bioremediation to engineered therapeutic probiotics. Another project in the group focuses on interfacing yeast cells with light harvesting nanoparticles to create inorganic-biohybrids with light-driven enhanced metabolic output.