Biologically fabricated materials from engineered microbes

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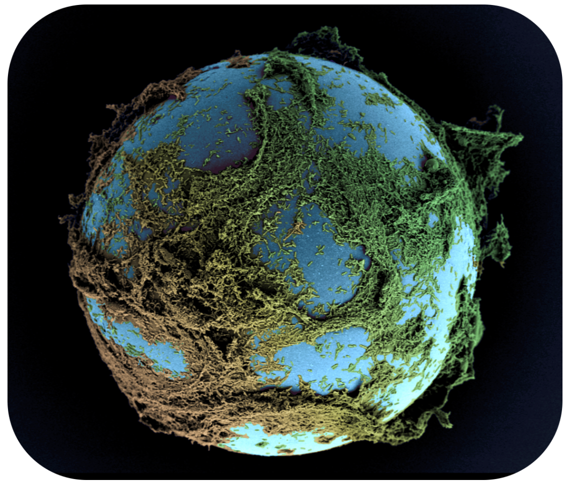

Bio

Neel Joshi is an Associate Professor in the Department of Chemistry and Chemical Biology at Northeastern University. He completed his PhD at UC Berkeley in the lab of Matt Francis and a postdoc at Boston University in the lab of Mark Grinstaff before starting his independent academic career at Harvard University and then moving to Northeastern in 2020. He is broadly interested in topics related to biologically inspired materials, protein engineering, self-assembly, and biointerfaces. His group works at the intersection of biomaterials science and synthetic biology. Recent projects in the group have focused on repurposing bacterial biofilms and their matrix proteins for biotechnological and biomedical applications.

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 fabricating bioplastics from engineered microbes producing customized curli fibers.