Functional protein materials produced by engineered bacteria

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Abstract

Protein-based materials represent sustainable and easily customizable alternatives to conventional synthetic polymers. With their biocompatibility, bioactivity and genetic tunability, proteins can be customized for a range of applications. Specifically, protein materials that self-assemble into macromolecular structures and can be produced at large scale are of interest for deployment into wearable devices, tissue scaffolds, and alternatives for commodity materials like plastics, textiles and electronics. Curli fibers produced by Escherichia coli bacteria represent a very promising protein scaffold due to their unique physicochemical properties. Once secreted by bacteria cells, CsgA subunits, the self-assembling repeats of curli fibers, form fibrous structures that can further aggregate and gel into macroscopic materials.

In this talk, I will describe advances from our group to engineer curli fibers and confer them with properties relevant for biosensing devices and porous mineralization scaffolds. First, I will present a strategy to fabricate wearable sensors made of genetically engineered curli fibers embedded in a textile matrix. Second, I will describe how the self-assembly mechanism of curli fibers can be utilized to drive the assembly of small peptides into supramolecular materials. Among other functionalities, we have genetically encoded in CsgA the ability to fluoresce in response to pH changes, and the ability to nucleate mineral particles. These functional protein constructs serve as proof-of-concept for the development of biocompatible scaffolds and sensing platforms and expand the diversity of functional protein-based devices.

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