Redesign of Protein Interfaces for the Assembly of Functional Biomaterials

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The fabrication of nanoscale devices requires architectural templates on which to position functional molecules in complex arrangements. Protein scaffolds are particularly promising templates for nanomaterials due to inherent self-assembly capabilities combined with genetically encoded functionalities. This presentation will highlight recent engineering of modular protein subunits for self-assembly into geometrically defined templates. The central protein building block in the creation of these templates is gamma-prefoldin (gPFD), a filamentous protein chaperone from a hyperthermophilic archaeon. Redesign of the gPFD subunit interface enabled the creation of two and three-way connectors that can link multiple filaments into macromolecular assemblies. Multiple unique interfaces can also be created between filament subunits to produce distinct monomers that assemble in repeating orders into dynamic structures. These protein templates are now being applied to achieve complex patterning of functional molecules, such as enzymes for applications in metabolic engineering. Fusing different enzymes to each subunit enables periodic positioning of multiple enzymes along the filament to catalyse sequential reactions. In addition, cytochrome c proteins can be aligned at high density along filaments as to create electrically conductive nanowires. Ultimately, these strategies will enable the design of smart biomaterials for complex applications that require multifunctionalities, such as drug delivery systems, biosensors, and bioelectronic devices.

Biography

Dominic Glover is a protein engineer and synthetic biologist. He graduated with a PhD in Biochemistry from Monash University. Subsequently, he conducted postdoctoral research at UC Berkeley for the development of self-assembling protein templates. In 2017 he joined the School of Biotechnology and Biomolecular Sciences at the University of New South Wales as a Senior Lecturer in synthetic biology. His research activities seek to understand and exploit the remarkable fidelity and precision of protein self-assembly for biotechnology.