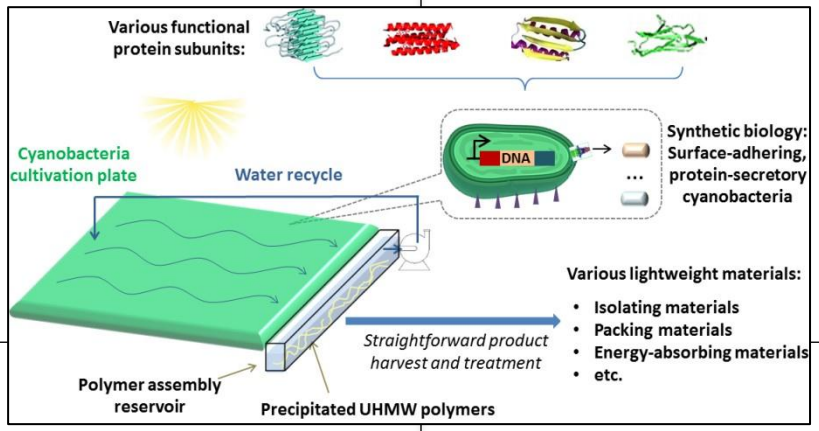
Engineering Cyanobacteria for the Production of Lightweight Materials

PI: **Fuzhong Zhang**
Department of Energy, Environmental & Chemical Engineering
Washington University in St. Louis

Figure Caption: Functional subunits of a material protein, either from natural materials or designed by computational approaches, can be encoded in synthetic DNA cassettes and expressed in engineered cyanobacteria that grow on a late to synthesize UHMW polymers and copolymers with controlled sequences and sizes. The synthesized protein polymers can be easily processed to lightweight materials, suitable for a range of NASA applications.



Research Objectives

- **Objective:** To engineer a cyanobacteria platform for manufacturing lightweight, high-performance materials via in situ resource utilization (ISRU, from solar energy and CO2, with regeneration of O2).
- **Innovation:** to develop novel synthetic biology hosts to synthesize ultra-high molecular weight (UHMW) protein materials with controlled size and monomer order, unobtainable by current SOA
- Start from TRL1 to study principles in protein secretion and assembly. End with TRL2 to prove the concept of a cyanobacterial material platform and demonstrate the feasibility.

Approach

- Engineer Synechocystis to secret functional protein subunits.
- Control the order and size of UHMW protein polymers.
- Identify major Synechocystis proteases whose deletion substantially increases protein yield and integrity.
- Engineer outer membrane protein to enable cell growth on solid surfaces.

Potential Impact

- Enable sustainable production of a range of lightweight, high- performance materials via ISRU for various space exploration application.
- Provide tools to control protein secretion and degradation in cyanobacteria and to cultivate cyanobacteria on solid surfaces.
- Pave the road for sustainable production of materials, bringing transformative changes to synthetic biology in material science.