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Versatile Biocatalyst System for Synthesizing Chemicals, Pharmaceuticals and Food Ingredients

IP Status: Pending US Patent; **Application #:** 16/632,941

Robust and Modular Self-Assembling Protein Scaffold

An innovative protein-based scaffold optimizes the spatial connections among multiple enzymes in biocatalytic reactions. This technology uses a new type of self-assembling protein to form the scaffold and a better tagging system for attaching enzymes on the scaffold. This combination significantly improves biosynthetic efficiency with a robust and modular self-assembling protein scaffold (using the bacterial microcompartment shell protein EutM from Salmonella enterica) and methods to localize cargo proteins to the scaffold using SpyTag-Spycatcher. The protein scaffold includes EutM subunits and a multi-enzyme cascade of enzymes attached to the EutM subunits. The scaffold may be self-assembled, in vivo or in vitro, by incubating EutM subunits so they self-assemble into a protein scaffold. Scaffolding of enzymes can reduce diffusion of reaction intermediates and increase reaction efficiency. Synthetic scaffolds have been shown to significantly increase the function of different designed pathways.

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Biocatalysis Spatial Organization Alternative

Industrial biocatalysis (using enzymes instead of chemical catalysts to transform organic compounds) is one option for producing valuable commodity chemicals, pharmaceuticals, and fuels that are difficult or impossible to synthesize chemically. Optimizing spatial organization of these enzymes (e.g., bringing enzymes in close proximity in cascade reactions) can significantly increase biocatalysis efficiency. However, biocatalysis is challenged in co-localization of enzymes in a cascade to optimize reaction conditions. Current strategies of spatial organization include 1) linking enzymes through fusion proteins, 2) immobilizing enzymes on solid surface with chemical linkers, 3) clustering enzymes on protein- or nucleic acid-based scaffolds, and 4) encapsulating enzymes in lipid or protein-based vesicles. This technology provides an

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Category
Engineering & Physical Sciences/Chemicals
Life Sciences/Industrial Biotech
Life Sciences/Research Tools
Agriculture & Veterinary/Food Science & Nutrition

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alternative to these strategies by providing a self-assembling scaffold and attachment system that allows for co-localizing enzymes in multi-enzyme biocatalytic cascades.

BENEFITS AND FEATURES:

- Rapid in vitro prototyping of scaffolds from different building block modules to optimize catalyst microenvironments and spacing
- Optimizes spatial connections among multiple enzymes in biocatalytic reactions
- Robust and modular self-assembling protein scaffold uses the bacterial microcompartment shell protein EutM from Salmonella enterica
- Scaffold may be self-assembled in vivo or in vitro
- Scaffolding of enzymes has the potential to increase reaction efficiency
- Synthetic scaffolding increases the function of different designed pathways
- Co-localizes enzymes in multi-enzyme biocatalytic cascades
- Large-scale recombinant production of assembly building blocks and catalysts
- Catalyst recycling enables efficient, cost effective catalyst use
- Ready for future incorporation in cell-free production systems

APPLICATIONS:

- Biosynthesis of chemicals, pharmaceuticals or food ingredients difficult or impossible to synthesize chemically
- Diagnosis/detection kits or tools that require multiple-enzyme reactions (for industrial, scientific, medical and/or environmental purposes)

Phase of Development - Proof of Concept

Researchers

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Publications

Spatial organization of multi-enzyme biocatalytic cascades
Organic & Biomolecular Chemistry, 2017, 15, 4260-4271
Self-Assembling Protein Scaffold System for Easy in Vitro Coimmobilization of Biocatalytic Cascade Enzymes
ACS Catalysis, May 11, 2018, 8, 5611-5620

Files and Attachments

Self-assembling Scaffolds for Biocatalysis NCS [PDF]

Interested in Licensing?

The University relies on industry partners to scale up technologies to large enough production capacity for commercial purposes. The license is available for this technology and would be for the sale, manufacture or use of products claimed by the issued patents. Please contact us to share your business needs and technical interest in this biocatalysis technology and if you are interested in licensing the technology for further research and development.

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