Genetically encoded hybrid biomaterials that are thermally responsive and tunable

Unmet Need

Developing new biomaterials is an active area of research, with applications in tissue engineering, regenerative medicine, and drug-delivery. In particular, protein- and peptide-based materials are attractive candidates for these applications because of their well-defined composition (e.g., sequence and length), their lack of toxicity, and their biodegradability. However, compared to synthetic polymers, the precision offered by recombinant expression is offset by their limited compositional repertoire that consists of the twenty canonical amino acids. One strategy to expand the diversity of protein-based materials is post-translational modification (PTM), a large and diverse class of chemical transformations carried out on proteins within cells after their expression that nature uses to diversify the proteome. PTMs play an important role in modifying the function and localization of polypeptides in the cellular environment, as well as the material properties of structural proteins and biological matrices. Post-translational modification (PTM) of proteins is a strategy employed in biological systems to expand the diversity of the proteome and to tailor the function and localization of proteins within cells as well as the material properties of structural proteins and matrices. Despite their ubiquity in biology, with a few exceptions, such as the recombinant expression of collagen and mussel foot protein, there is still a need for the use of PTMs to synthesize hybrid biomaterials with properties suitable for applications such as tissue engineering, regenerative medicine, and drug-delivery.

Technology

Duke inventors have reported a tunable, hybrid biomaterial intended for applications such as tissue engineering, regenerative medicine, and drug delivery. This is a genetically encoded biohybrid material created through post-translational modification. The inventors have developed multiple stimulus-responsive hybrid materials—fatty-acid-modified elastin-like polypeptides—using a one-pot recombinant expression and post-translational lipidation methodology. These hybrid biomaterials contain an amphiphilic domain, composed of a β-sheet-forming peptide that is post-translationally functionalized with a C14 alkyl chain, fused to a thermally responsive elastin-like polypeptide (ELPs). Elastin-like polypeptides (ELPs) exhibit lower critical solution temperature phase behavior, enabling them to form gel-like depots that increase the half-life of their cargo. This technology exhibits temperature-triggered hierarchical self-assembly across multiple length scales with varied structure and material properties that can be controlled

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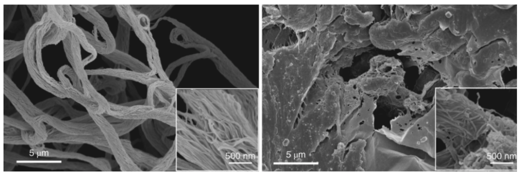
LICENSING & VENTURES



Duke File (IDF)

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at the sequence level.

Advantages

- Thermally responsive, tunable biomaterial that can be extrinsically triggered to self-assemble on-demand
- The genetically encoded, one-pot synthesis is carried out by E. coli and is therefore easy to scale-up and manufacture

Publications

- Genetically encoded lipid–polypeptide hybrid biomaterials that exhibit temperature-triggered hierarchical self-assembly (Nature Chem, 2018)
- US Patent App 16/477,229

Patents

Patent Number: PCT/US2018/013611

Title: GENETICALLY ENCODED LIPID-POLYPEPTIDE HYBRID BIOMATERIALS THAT EXHIBIT TEMPERATURE TRIGGERED HIERARCHICAL SELF-ASSEMBLY

Country: United States of America