MIT Chemical Engineering Department

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Controlling and Understanding Protein Self-Assembly for Development of Therapeutic Materials

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66-110

Abstract: Proteins can provide therapeutic functions simply not possible with small molecule drugs, but their large size and folded structure present critical challenges in terms of delivery, stability and activity. We take advantage of protein size, structure and the ability to interact with other proteins, in order to create therapeutic protein materials via self-assembly routes not available for small molecules. The ability to control assembly of therapeutic proteins is essential to manipulating the final physical properties of the material, ensuring retention of protein activity, and directing the interactions between materials and cells.

In this presentation, I will describe the development, characterization and performance of two different functional protein assemblies, intracellular antibody Hex nanocarriers and globular protein vesicles. The Hex carriers seek to open up the intracellular space for antibodies as an approach to aim at "undruggable" intracellular protein targets. The vesicles, themselves made from functional proteins, aim to present protein and small molecule cargo for a variety of applications. In each case we applied a rational protein design strategy to enable self-assembly and have performed extensive characterization to understand the structures formed, their dynamics and stability, and how to tune the material properties for specific applications. These properties significantly affect how the protein assemblies interact with biological systems and the current status of application of these materials towards therapeutic targets will be shared.