

Construction of Artificial Protein Self-Assemblies and Their Pharmaceutical Applications

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A hallmark of biological systems is the presence of sophisticated and highly efficient protein machinery, where proteins can self-assemble into highly ordered nanostructures with complex functionalities. Inspired by naturally occurring protein self-assemblies, researchers have explored novel strategies to design artificial protein-based nanostructures. Among these, protein-polymer conjugates have emerged as a unique class of biohybrid macromolecules that integrate the biological activity of native proteins with the multifunctionality of synthetic polymers. Drawing inspiration from natural protein self-assemblies, we have effectively combined site-specific protein modification techniques with advanced polymer chemistry and biomineralization strategies to develop two innovative self-assembly approaches: *site-specific in situ polymerization-induced self-assembly/co-assembly (SI-PISA/SI-PICA)*¹⁻⁷ and *biomineralization-induced self-assembly (BIS)*.⁸ These approaches have enabled the construction of diverse protein self-assembly systems that not only preserve the biological activity of proteins but also significantly enhance their pharmaceutical properties, including pharmacokinetics, tumour targeting, and antitumor efficacy.² Building upon these advances, we have further explored and expanded the applications. These include intracellular carriers for protein therapeutics¹ and chemotherapeutic agents,⁷ glucose detection reagents for blood sugar monitoring,⁴ radiosensitizing nanomedicines for enhanced radiotherapy,⁸ and nanogels designed to modulate metabolic pathways in oral tumours. Through these innovations, protein-based self-assembled systems offer promising new directions for biomedical applications.

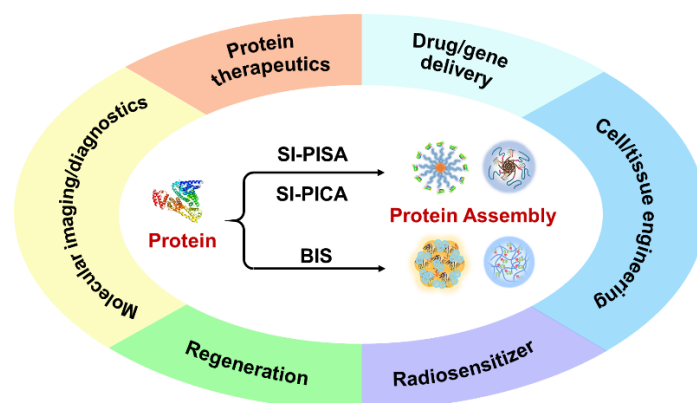


Figure 1: Construction of Artificial Protein Self-Assemblies and Their Pharmaceutical Applications

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