Hierarchical Self-organization of Polymersomes and Janus Nanoparticles Mediated by DNA

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A significant approach in various fields such as chemistry, electronics, and technology is the self-organization of nano-objects into complex architectures. This strategy aims to generate novel systems with unique properties and functionalities [1–3]. An important step in creating interconnected artificial organelles is the DNA hybridization between synthetic assemblies, including polymersomes, nanoparticles, and micelles. These assemblies facilitate cascade reactions among different encapsulated catalytic compounds and can imitate cell signaling and interactions[4,5].

In this study, we explore the self-organization of clusters formed by "hard" Janus nanoparticles (JNPs) and "soft" polymersomes, presenting a universal approach to developing a hybrid system with multiple functions for specific bio-applications. The polymer-based JNPs possess anisotropic composition and orthogonally addressable functionality, making them an asymmetric platform suitable for directional interactions[6,7] with the soft polymersomes. These clusters are formed through the hybridization of complementary ssDNA strands attached to each component. While adhering to the surface of the "hard" JNPs, the polymersomes undergo deformation but maintain their structural integrity due to the robustness of the block copolymer membrane. Notably, the polymersomes retain their vesicular architecture even after assembly into JNP-polymersome clusters, allowing for the encapsulation of various types of functional cargo[8]. Lastly, the study investigates the biocompatibility of these clusters and their interactions with cell surfaces, facilitated by scavenger receptors.

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