Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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Tunable Nanoscale Hybrid Cages

The programmable nature and vast utility of three-dimensional cages makes them an important target for nanotechnology. While proteins and DNA have both been used as building blocks to create tunable nanoscale cages, each molecular type has its own limitations. Tuning nanoscale parameters in protein nanocages typically requires the entire system to be reengineered with a different set of proteins. While tuning of DNA nanocages is much easier, the nanostructures are restricted to the physical and chemical properties of the DNA duplex and require peptides or proteins to provide them with bioactivity.

Researchers at the Biodesign Institute of Arizona State University have developed novel hybrid cages where self-assembling protein building blocks are merged with addressable DNA scaffolds to combine the bioactivity of protein cages with the tunability of DNA cages. The dimensions of the protein-DNA cage can be tuned by modifying the number of turns per DNA arm. A wide range of cages can be synthesized or used to organize other DNA-based materials such as tiles or other nanostructures.

These self-assembling tunable cages have the advantages of both protein and DNA nanotechnology and will find great utility in targeted delivery, structural biology, biomedicine and more.

Potential Applications

- Carriers - transporting cargo for targeted imaging or drug delivery
- Confining catalysts in nanoscale reactors
- Positioning chemical elements to mimic photosynthesis
- Programmable molds or amphiphiles for nanoparticle synthesis & encapsulation
- Structural Biology – fiducial marker
- Biomedicine
- Light harvesting & artificial photosynthesis

Benefits and Advantages

- Self-assembling
- Highly stable
- Rational tuning – doesn’t require extensive expertise
- Can be functionalized
- Multivalent targeting
- Hierarchical organization of molecules such as small molecules, peptides, proteins, etc.
- Controlled angular orientation and rigidity of the protein-DNA nanostructure interface

For more information about this opportunity, please see

Xu et al - ACS Nano - 2019

For more information about the inventor(s) and their research, please see

Dr. Marvi's departmental webpage