Biomaterials Plenary Session: Materials and Biology for the Future of Energy and the Environment
Room On Demand - Session BP-Invited On Demand

Biomaterials Plenary Invited On Demand Session

BP-Invited On Demand-1 Programmable Icosahedral Shell System for Virus Trapping*, Hendrik Dietz,* TU Munich, Germany **INVITED**

Broad spectrum antiviral platforms that can decrease or inhibit viral infection would alleviate many threats to global public health. Nonetheless, effective technologies of this kind are still not available. Here we describe a programmable icosahedral canvas for the self-assembly of icosahedral shells that have viral trapping and antiviral properties. Programmable triangular building blocks constructed from DNA assemble with high yield into various shell objects with user-defined geometries and apertures. We create shells with molecular masses ranging from 43 to 925 Megadaltons (8 to 180 subunits) and with internal cavity diameters ranging up to 280 nm. The shell interior can be functionalized with virus-specific moieties in a modular fashion. We demonstrate this virus-trap concept by engulfing hepatitis B virus (HBV) core particles and adeno-associated viruses (AAV). We show inhibition of HBV core interactions with surfaces in vitro and demonstrate neutralization of infectious AAV exposed to human cells.

C. Sigl, E.M. Willner, W. Engelen, J.A. Kretzmann, K. Sachenbacher, A. Liedl, F. Kolbe, F. Wilsch, S.A. Aghvami, U. Protzer, M.F. Hagan, S. Fraden, and H. Dietz, "Programmable icosahedral shell system for virus trapping", Nature Materials (2021), doi: 10.1038/s41563-021-01020-4

BP-Invited On Demand-7 Reaction Microenvironments Formed by Bioinspired All-Aqueous Phase Separation*, Christine Keating,* Penn State University **INVITED**

Biological cells are highly organized with numerous subcellular compartments, many of which lack membranous boundaries. We are developing simple experimental models for these membraneless organelles based on liquid-liquid phase separation. Phase coexistence is a common phenomenon in aqueous solutions of polyelectrolytes and other macromolecules. Solutes such as ions, small molecules, and biopolymers can become compartmentalized by partitioning between the phases. This generates microenvironments that can impact reaction locations, rates, and outcomes. For example, RNA can be accumulated within polymer-rich aqueous droplets, enhancing ribozyme reaction rates. Distinct physicochemical properties of adjacent phases within multiphase droplets can enable solute sorting, such as accumulating single-stranded versus double-stranded RNAs in different phases, and can impact binding thermodynamics. Bioinspired compartmentalization by aqueous phase coexistence is of interest for understanding biological cells, their prebiotic ancestors, and their artificial analogues, and more generally for bioreactors. For example, multiphase all-aqueous emulsion droplets enable pre-organization of local reaction microenvironments to control the structure and local composition of organic/inorganic composite materials during synthesis.

Author Index

Bold page numbers indicate presenter