

MAR17-2016-030061

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Active control of complex, multicomponent self-assembly processes

REBECCA SCHULMAN, Johns Hopkins University

The kinetics of many complex biological self-assembly processes such as cytoskeletal assembly are precisely controlled by cells. Spatiotemporal control over rates of filament nucleation, growth and disassembly determine how self-assembly occurs and how the assembled form changes over time. These reaction rates can be manipulated by changing the concentrations of the components needed for assembly by activating or deactivating them. I will describe how we can use these principles to design driven self-assembly processes in which we assemble and disassemble multiple types of components to create micron-scale networks of semiflexible filaments assembled from DNA. The same set of primitive components can be assembled into many different, structures depending on the concentrations of different components and how designed, DNA-based chemical reaction networks manipulate these concentrations over time. These chemical reaction networks can in turn interpret environmental stimuli to direct complex, multistage response. Such a system is a laboratory for understanding complex active material behaviors, such as metamorphosis, self-healing or adaptation to the environment that are ubiquitous in biological systems but difficult to quantitatively characterize or engineer.