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Controlling the temperature-dependent assembly of DNA-coated colloids with toehold exchange WILLIAM ROGERS, JESSE COLLINS, Harvard SEAS, VINOTHAN MANOHARAN, Harvard SEAS and Physics — DNA is increasingly being used as a tool for directing the self-assembly of particle-based systems. The transient bridging of grafted, complementary DNA strands induces specific, attractive interactions that can direct nanoparticles or colloids to form clusters, ordered crystal lattices, or other interesting structures. In most cases, the DNA-induced binding strength is a monotonic and near exponential function of temperature, resulting in a single, narrow temperature window for equilibrium assembly that may frustrate efforts to make multicomponent or hierarchical structures. Here, we present and quantitatively demonstrate a new approach to controlling the temperature dependence of DNA-induced colloidal interactions using toehold exchange hybridization, a concept borrowed from dynamic DNA nanotechnology. These competitive hybridization pathways allow additional control over the thermodynamics of bridge formation and provide a simple way to engineer novel temperature dependences that need not be exponential or monotonic. This additional functionality will be useful in the rational design of new multicomponent, hierarchical, or reconfigurable self-assembling systems.

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