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Topological Interaction by Entanglement of DNA
LANG FENG, Center for Soft Matter Research, New York University, RUOJIE SHA, NADRIAN SEEMAN, Chemistry department, New York University, PAUL CHAIKIN, Center for Soft Matter Research, New York University — We find and study a new type of interaction between colloids, Topological Interaction by Entanglement of DNA (TIED), due to concatenation of loops formed by palindromic DNA. Consider a particle coated with palindromic DNA of sequence "P1." Below the DNA hybridization temperature (T_m), loops of the self-complementary DNA form on the particle surface. Direct hybridization with similar particle covered with a different sequence P2 do not occur. However when particles are held together at $T > T_m$, then cooled to $T < T_m$, some of the loops entangle and link, similar to a Olympic Gel. We quantitatively observe and measure this topological interaction between colloids in a $\sim 5°C$ temperature window, $\sim 6°C$ lower than direct binding of complementary DNA with similar strength and introduce the concept of entanglement binding free energy. To prove our interaction to be topological, we unknot the purely entangled binding sites between colloids by adding Topoisomerase I which unconcatenates our loops. This research suggests novel history dependent ways of binding particles and serves as a new design tool in colloidal self-assembly.

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