Reversibly Switchable DNA Nanocompartment on Surfaces

Qi Ouyang and You-Dong Mao

Center for Theoretical Biology and School of Physics, Peking University, 100871 Beijing, China
E-mail: qi@pku.edu.cn

Biological macromolecules have been used to fabricate many nanostructures, bio-devices, and biomimetics because of their physical and chemical properties. But dynamic nanostructure and bio-machinery that depend on collective behavior of biomolecules have not been demonstrated. We report the design of DNA nanocompartment on surfaces that exhibit reversible changes in molecular mechanical properties. Such molecular nanocompartment is served to encage molecules. We found that ‘fuel’ strands with single-base variation cannot afford an efficient closing of nanocompartment, which allows highly sensitive label-free DNA array detection. A dynamic model is formulated in order to understand the mechanism of the nanocompartment. Considering the flexibility of DNA nanochannels, the channel-particle interactions result in a dual switching criticality with channel gating correlated to single-file flux pumping, leading to macroscopic equilibrium consequences measured by experiments on DNA nanocompartment.