DNA Spaceship

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The emergence of DNA nanotechnology has led to the design and bottom-up construction of a wide range of artificial nanostructures with spatially diverse addressable shapes, two- and three-dimensional (2D and 3D) geometries, and functions as well as nanodevices and nanomachines. With a high level of structural programmability and obvious biocompatibility, accurately controlled and self-assembled DNA origami is emerging as a strong candidate for delivery of small biomolecules in living systems.

Hence, this year, we design a GNP-DNA origami complex, which possess both photothermal properties associated with GNPs and programming properties intrinsic to DNA. The complex responds to optical stimulation, since we modified GNPs on particular margin-staple strand, just like the zipper on the clothes. Once given the range intensities of optical stimulation, we prospect that the generated heat by GNPs can separate the staple strand with breaking the hydrogen bonds of surrounding double-strand DNA, and open the occlusive DNA origami case. To avoid the reclosing of origami, we develop a special stranddisplacement reaction towards the link between GNPs and DNA origami.

Our device is photo-triggerable, which embrace remote controllability, low systemic toxicity and few side effects. We select to motivate the photothermal induction of GNPs by Near-infrared irradiation (NIR irradiation), because NIR irradiation can penetrate deeper in tissues and cause less photodamage in comparison to visible light and UV-vis irradiation.

Finally, by introducing gold nanoparticles into DNA origami, we demonstrate the device as an efficient light-controllable switch, making this a promising candidate platform for unique potential applications intended for anticancer therapy, nanorobot and protein synthesis in vitro.