Photocontrolled assembly of DNA origami nanostructures using photoswitching molecules

([1]*Department of Chemistry, Graduate School of Science, Kyoto University,* [2]*Institute for Integrated Cell-Material Sciences, Kyoto University*)

Shubham Mishra[1], Soyoung Park[1], Tomoko Emura[1], Kumi Hidaka[1], Hiroshi Sugiyama[1,2], Masayuki Endo[1,2]

Keywords *: DNA origami, photoswitch, programmed assembly, single-molecule observation*

There has been significant research on stimuli-responsive molecules for the purpose of mechanical of biomolecules.[1] A class of molecules called Arylazopyrazole (AAP) was recently developed and shows photoisomerization activity, displaying a faster response to light-induced conformational changes and unique absorption spectral properties compared with those of conventionally used azobenzene.[2] Herein, it is shown how AAP can be used as a photoswitching molecule to control photoinduced assembly and disassembly of DNA origami nanostructures. An AAP-modified DNA origami was designed and constructed and it was observed that the repeated assembly and disassembly of AAP-modified X-shaped DNA origami and hexagonal origami with complementary strands can be achieved by alternating UV and visible-light irradiation. Closed and linear assemblies of AAP-modified X-shaped origami were successfully made to form by photoirradiation, and more than 1 μm linear assemblies were formed. Finally, it is shown that the two photoswitches, AAP and azobenzene,[3] can be used together to independently control different assembly configurations by using different irradiation wavelengths (Figure 1). AAP can extend the repertoire of available wavelengths for photoswitches and stably result in the assembly and disassembly of various DNA origami nanostructures.[4]

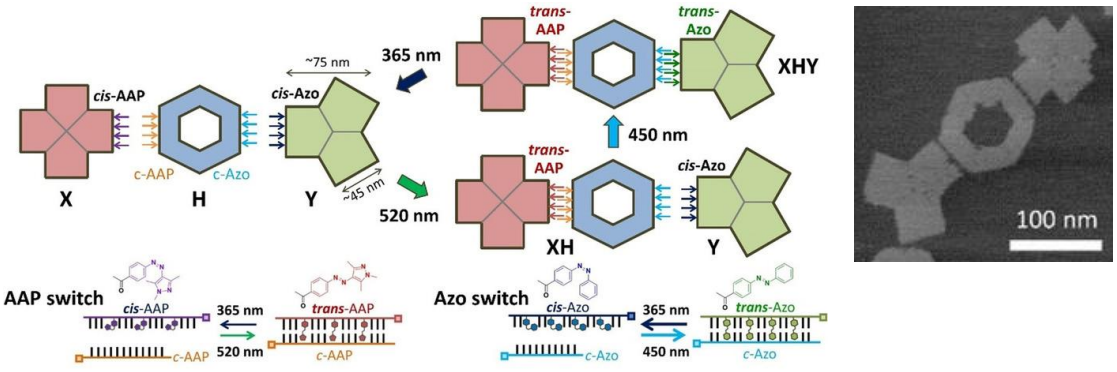

Figure 1. Photo-induced selective DNA origami assembly using AAP and azobenzene photoswitches with photoirradiation at corresponding wavelengths. AFM image of hetero timer assembly.

1. F. Wang, X. Liu, I. Willner, *Angew. Chem. Int. Ed.* **2015**, 54, 1098– 1129.
2. V. Adam, D. K. Prusty, M. Centola, M. Skugor, J. S. Hannam, J. Valero, B. Klockner, M. Famulok, *Chem. Eur. J.* **2018**, 24, 1062–1066.
3. X. Liang, T. Mochizuki, H. Asanuma, *Small* **2009**, 5, 1761– 1768.
4. S. Mishra, S. Park, T. Emura, H. Kumi, H. Sugiyama, M. Endo, *Chem. Eur. J.* **2021**, 27, 778–784.