Photocontrol of DNA origami melting using photosensitive intercalators

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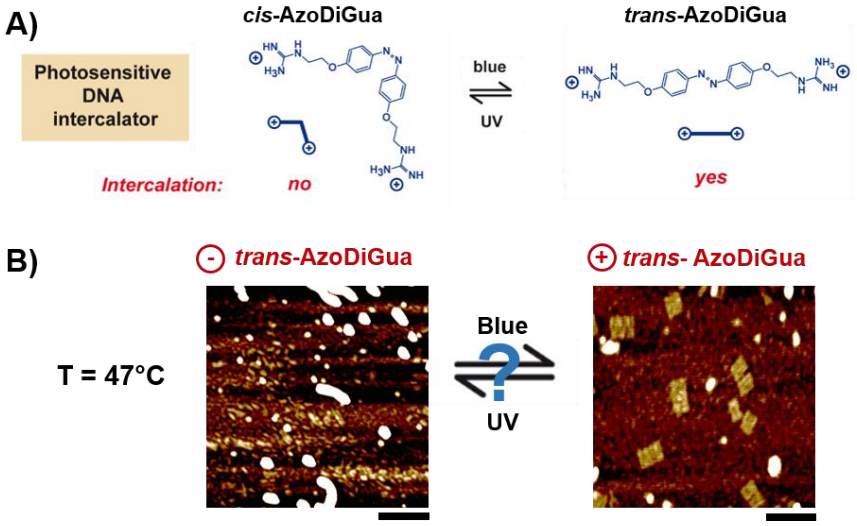
DNA nanotechnology exploits the perfect specificity of the Watson-Crick base-paring to create elaborate objects through a bottom-up process. Amidst this rapidly expanding technology field, DNA origami has proved to be an efficient way to create highly complex 2D and 3D nanostructures with arbitrary programmable shapes[1]. To do so, a single stranded circular DNA molecule is folded by self-assembly with a large number of complementary small oligonucleotides called "staples", whose sequence distribution defines the final origami shape. Unless addition of a competitive oligonucleotide, these objects remain however usually static at constant temperature. Our objective is to render origamis dynamic by achieving a photoreversible control of their melting at constant temperature using a photosensitive intercalator, AzoDiGua, which has been recently developed by our group[2].



A) Structure and isomerization conditions of AzoDiGua.

B) DNA origami stabilization by *trans*-AzoDiGua against temperature and photocontrol perspectives. Scale bar 100 nm.

AzoDiGua (Fig. A)) has the unique property to intercalate DNA only in its *trans*-form thus stabilizing the double-helix and inducing a marked increase in its melting temperature (Tm). Upon UV irradiation, AzoDiGua isomerizes into its cis-form, which is ejected from the double-helix resulting in a decrease in Tm that can be recovered upon blue irradiation.

We thus developed a protocol to prepare origamis incorportating AzoDiGua, and studied the melting behaviour of origamis as a function of temperature and buffer conditions. Strikingly, we identified conditions where origamis were melted at 47°C but fully formed at the same temperature in the presence of *trans*-AzoDiGua (Fig. B)). We are currently studying whether those two states could be photoreversibly obtained at fixed temperature.

1. Rothemund P. W. K. *Folding DNA to Create Nanoscale Shapes and Patterns*, Nature 440, 297–302, 2006
2. Bergen A, Rudiuk S, Morel M, Le Saut T, Ihmels H, Baigl D, *Photodependent Melting of Unmodified DNA Using a Photosensitive Intercalator: A New and Generic Tool for Photoreversible Assembly of DNA Nanostructures at Constant Temperature*, Nano Lett. 16, 773–780, 2016