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\(^2\).

AzoDiGua (Fig. A)) has the unique property to intercalate DNA only in its \textit{trans}-form thus stabilizing the double-helix and inducing a marked increase in its melting temperature (Tm). Upon UV irradiation, AzoDiGua isomerizes into its \textit{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 incorporating 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 \textit{trans}-AzoDiGua (Fig. B)). We are currently studying whether those two states could be photoreversibly obtained at fixed temperature.

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