BioInspired Nanotechnology & High Speed AFM Instrumentation

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DNA based nanostructures built on a long single stranded DNA scaffold, known as DNA origamis, offer the possibility to organize various molecules at the nanometer scale in one pot experiments. The folding of the scaffold is guaranteed by the presence of short, single stranded DNA sequences (staples), that hold together separate regions of the scaffold. In this paper, we first consider simple structures made of three single-stranded oligonucleotides. Based on experimental (UV absorption) and numerical (replica exchange molecular dynamics simulations) data, we show that cooperativity is key to understand the thermodynamics of these constructions. In a second part, we derive a model of the annealing-melting properties of DNA origamis. The model captures important features such as the hysteresis between melting and annealing, as well as the dependence upon the topology of the scaffold. We also obtain temperature dependent average conformations that compare well to AFM images of quenched states of the partially folded origamis.

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