Replicable Single-stranded DNA Origami

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DNA molecules have been used to build a variety of complex nanoscale shapes and devices since the birth of DNA nanotechnology in 1982. In previous studies, multiple strands were successfully designed to self-assemble into complex structures with or without the help of a long scaffold strand. A biological macromolecule, e.g. mRNAs and protein, typically folds from a single polymer into a well-defined structures. It would be desirable for DNA nanotechnologists to be able to construct DNA nanostructures with a similar strategy. However, folding complex nanostructures from a single strand of DNA still remains challenging for the field of DNA nanotechnology, due to the complexity of the topology in most existing designs and the difficulty of large-scale clonal production of suitable DNA sequences. Unlike previous studies, which use multiple DNA molecules that self-assemble into a target structure, here we report the design and synthesis of single-stranded DNA origami structures (ssOrigami) containing up to 4000 nucleotides which can fold into designed shapes by a simple denaturation–renaturation procedure. Additionally, our ssOrigami can be easily amplified by polymerases in vitro and in vivo. ssOrigami structures can also be used as a template for amplification by PCR.