Discover Nano, vol.20, no.1, pp.77-1-77-10, December, 2025.

Rapid assembly of highly ordered DNA origami lattices at mica surfaces

A. Keller; B.K. Pothineni; D. Contreras Bárcena; G. Grundmeier; J. Barner; M. Castro Ponce

Abstract-

The surface-assisted assembly of DNA origami lattices is a potent method for creating molecular lithography masks. Lattice quality and assembly kinetics are controlled by various environmental parameters, including the employed surface, the assembly temperature, and the ionic composition of the buffer, with optimized parameter combinations resulting in highly ordered lattices that can span surface areas of several cm2. Established assembly protocols, however, employ assembly times ranging from hours to days. Here, the assembly of highly ordered hexagonal DNA origami lattices at mica surfaces is observed within few minutes using high-speed atomic force microscopy (HS-AFM). A moderate increase in the DNA origami concentration enables this rapid assembly. While forming a regular lattice takes 10 min at a DNA origami concentration of 4 nM, this time is shortened to about 2 min at a concentration of 6 nM. Increasing the DNA origami concentration any further does not result in shorter assembly times, presumably because DNA origami arrival at the mica surface is diffusion-limited. Over short length scales up to 1 µm, lattice order is independent of the DNA origami concentration. However, at larger length scales of a few microns, a DNA origami concentration of 10 nM yields slightly better order than lower and higher concentrations. Therefore, 10 nM can be considered the optimum concentration for the rapid assembly of highly ordered DNA origami lattices. These results thus represent an important step toward the industrial-scale application of DNA origami-based lithography masks.

Index Terms- DNA nanotechnology · Lattice formation · Hierarchical self-assembly · High-speed atomic force microscopy

Citation:
Barner, J.; Castro, M.; Contreras, D.; Grundmeier, G.; Keller, A.; Pothineni, B.K. "Rapid assembly of highly ordered DNA origami lattices at mica surfaces", Discover Nano, vol.20, no.1, pp.77-1-77-10, December, 2025.