Design and Construction of Double-Decker Tile as a Route to Three-Dimensional Periodic Assembly of DNA

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Supplementary information

DNA strands and tile formation. Synthetic oligonucleotides were purchased from Integrated DNA Technologies (Coralville, IA) in unpurified form and were purified using PAGE. Lattices were formed by annealing a stoichiometric quantity of each strand in a buffer consisting of 40 mM Tris (pH 7.6), 20 mM acetic acid, 2mM EDTA and 12.5 mM magnesium acetate (1xTAE/Mg^{++}). The final concentration of each strand was 0.5 μM. Annealing was performed by incubating the sample in a beaker containing boiling water and letting it cool down slowly in an insulated (styrofoam) box over 16 hours, followed by overnight incubation of the entire beaker at 4ºC.

AFM imaging. The annealed sample was diluted 30X in 1xTAE/Mg^{++} buffer. Then 5 μL of the diluted sample was spotted on freshly cleaved mica (Ted Pella, Inc.) and left to adsorb to the surface for 3 minutes. 30 μL of 1xTAE/Mg^{++} buffer was then placed onto the mica. Imaging was performed under 1xTAE/Mg^{++} in a fluid cell using tapping mode on a Multimode NanoScope IIIa with NP-S tips (Veeco Inc.).

Fluorescence microscopy. 5 μL of 0.5 μM sample solution was mixed with 5 μL of 30 ng/μL DAPI (4',6-diamidino-2-phenylindole) solution. First some gold antifade reagent is spotted onto a clean glass slide to minimize photo-bleaching of fluorescently labeled sample. Next 5 μL of the DNA sample mixed with the DAPI solution is spotted onto the same clean glass slide and left for 5 min to allow DNA arrays to adsorb onto the glass surface. The sample is then immediately protected with a cover-slip and imaged with a fluorescence microscope.

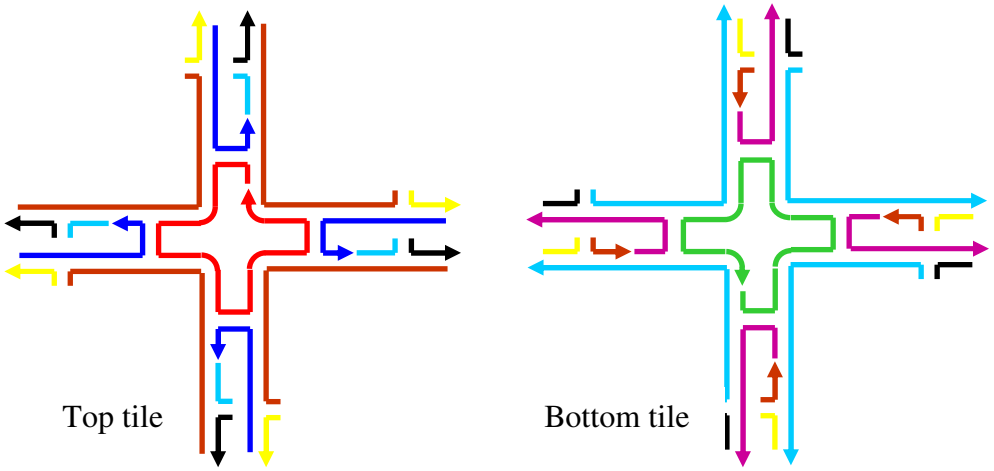

Figure S1. Strand trace for the double-decker tile. There are eight distinct strands involved, names and sequences of which are listed below according to the color-coding shown in the figure. The sticky ends are shown as protruding arrows. The central loop strands (S5 and S6, shown in red and green respectively) span over the four arms with the help of T_4 loops.

DNA sequences.

S1: 5' – GTC AAC TAC TTA CTC CAG GAC T – 3'

S2: 5' – CGG AGA TGA CCT TAG CAT CAG T – 3'

S3: 5' – ATG CTA AGG AAG TGA CGG TCA GAC ACC TGC TGG CAA GCC TAC GAT TGG ACG CGG TAT GGA ACG TAC ACG TGC CG – 3'

S4: 5' – ACC GTC ACT TCG CTT CTG TAT TCG ATC CGG TTC GTC TCG CCA ATC TAG TAT CGC GCA GTC GGC ACG TGT AGT TGA CAG TC – 3'

S5: 5' – AGC ACC AAT CGT AGG TTTT CTT GCC AGC ACC AAT CGT AGG TTTT CTT GCC AGC ACC AAT CGT AGG TTTT CTT GCC AGC ACC AAT CGT AGG TTTT CTT GCC – 3'

S6: 5' – AAC CAC TAG ATT GGC TTTT GAG ACG AAC CAC TAG ATT GGC TTTT GAG ACG AAC CAC TAG ATT GGC TTTT GAG ACG AAC CAC TAG ATT GGC TTTT GAG ACG – 3'

S7: 5' – CTG GAG TAA GTA CGT TCC ATA CCG CGT GGT GTC TG – 3'

S8: 5' – ACT GCG CGA TGG ATC GAA TAC AGA AGC GTC ATC TCC GAC TG – 3'

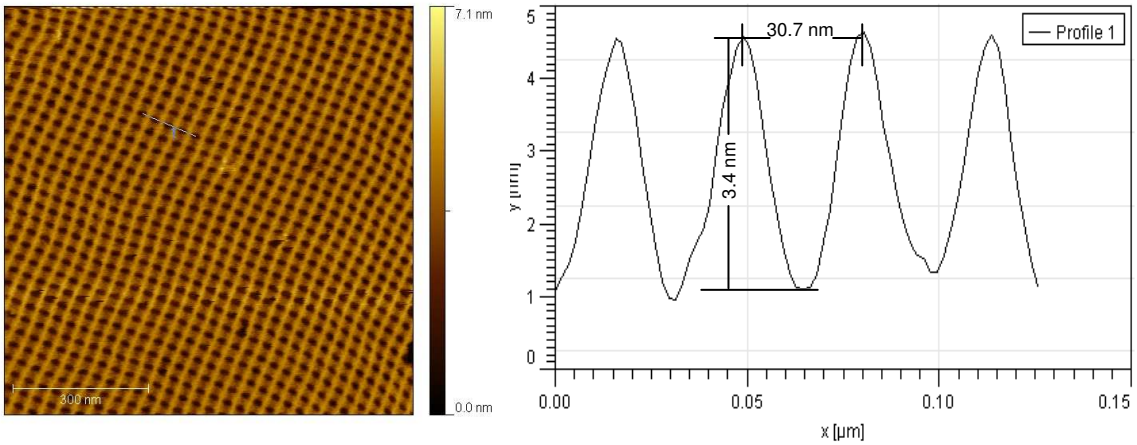

Figure S2. The AFM height profile of a section of the 2D double-decker lattice. The height of the lattice on mica is 3.4 nm, which corresponds to the width of two DNA double helices on mica. The periodicity of the lattice is 30.7 nm, which agrees with the theoretically predicted value of approximately 30 nm.

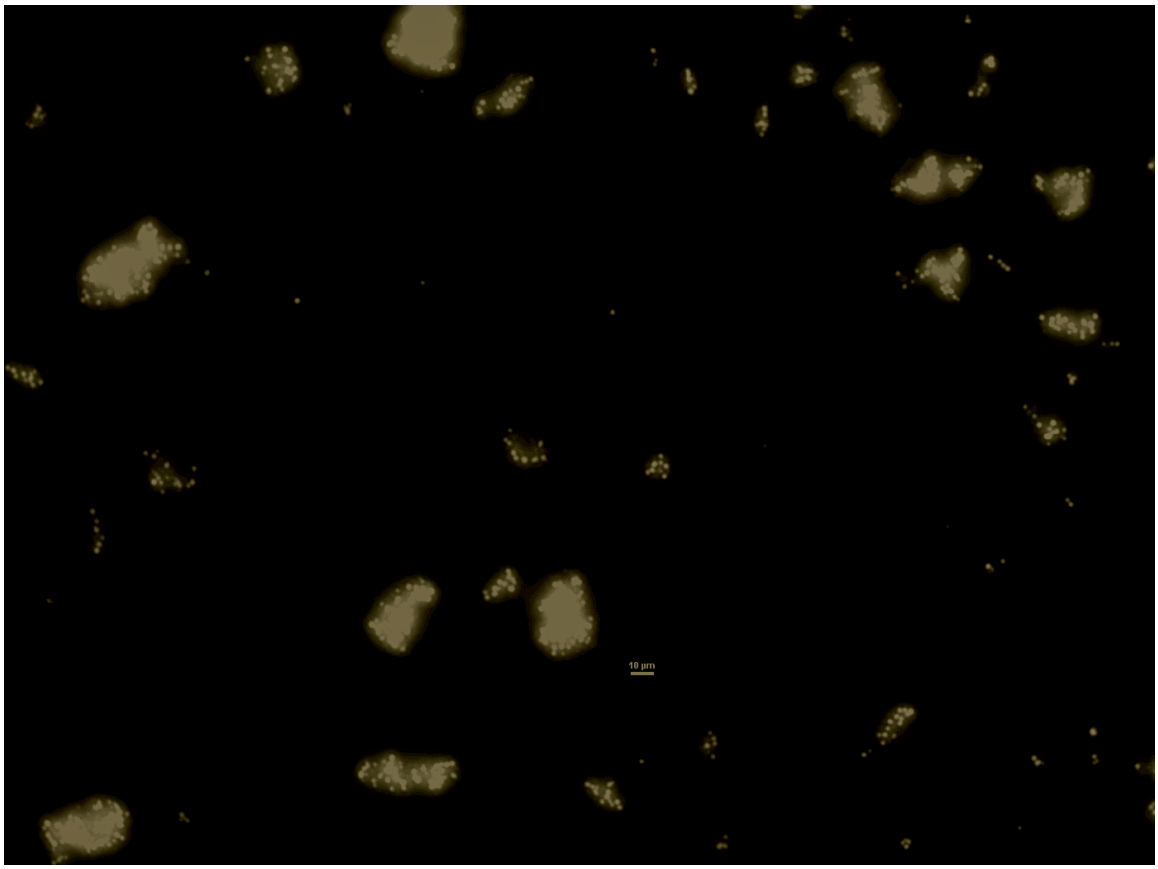

Figure S3. A wide view fluorescence microscopy image of the DAPI-stained double-decker tile lattice showing the prevalence of large lattice pieces in the sample. A scale bar of 10 microns is shown in the lower, middle of the image field.