Programmable and scalable assembly of a flexible hexagonal DNA origami

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Catalog

Design figures:

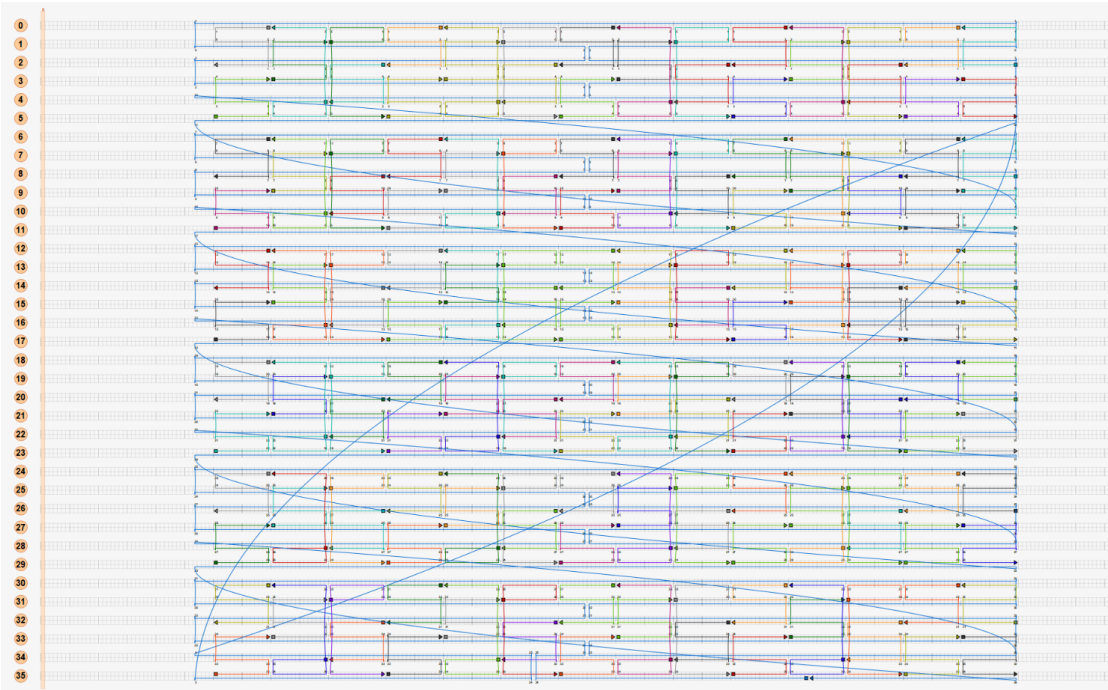

Figure 1. The caDNAno design figure of hexagonal origami.

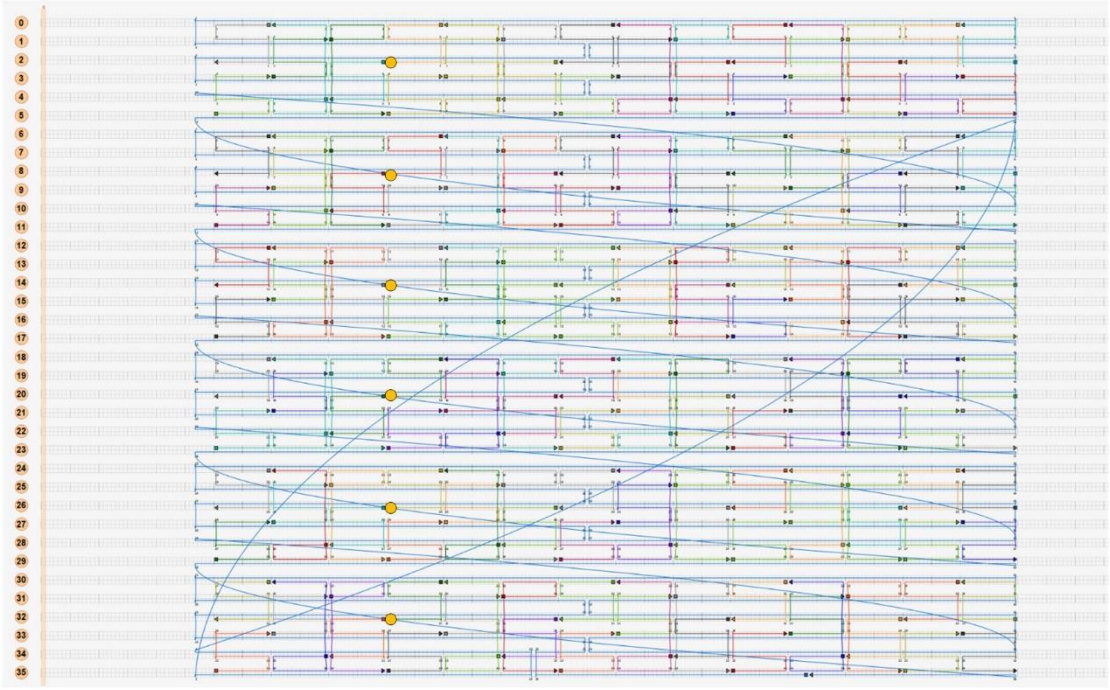

Figure 2. The yellow dots are the locations of biotin modified staple strands. They are illustrated in Table1.

Table1 Biotin modified strands.

Location	Sequence
6[97]8[84]	AATAGCAATAGCTATGGCATGATTAAGAGCAAAGACACCACGTTTTT
0[97]2[84]	TGCTGATGCAAATCTAAATAAGGCGTTACTTACCAGTATAAATTTTT
18[97]20[84]	ATCAACGTAACAAATTACCTTATGCGATGGAACAACATTATTTTTTT
24[97]26[84]	AGCATAAAGCTAAAATGCAATGCCTGAGCAACCGTTCTAGCTTTTTT
12[97]14[84]	GATAAGTGCCGTCGCAGAGCCACCACCCCTACAACGCCTGTATTTTT
30[97]32[84]	ACACAACATACGAGGTGCCAGCTGCATTGTGAGACGGGCAACTTTTT

We extended four poly-T at the 3’ end for biotin modification.

Purified Results

The concentration of purification samples via gel extraction is relatively low. All the view fields of supplemental AFM images were 2μm. Because biotin-streptavidin dots are not recognizable at a higher view, and we can not get enough samples at a lower view.

We marked all the potential biotin-streptavidin dots via green circles. The binding efficiency of streptavidin attachment, origami shape-changing are statistically calculated at the end of this section.

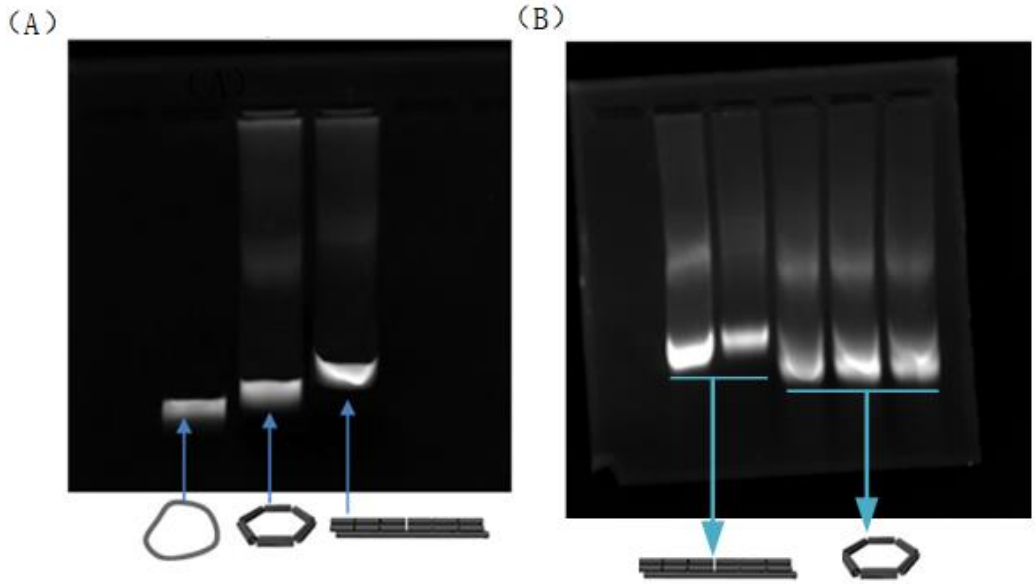

Figure 3. The Gel electrophoresis results. (A) The three lanes from left to right: M13; hexagonal origami; linear origami. (B) The two on the left are the linear origami. The three on the right are the hexagonal origami.

The molecular weight of linear origami is the same as that of hexagonal origami, but the linear origami has a larger morphological expansion and occupies a wider range of horizontal space. Therefore, it moves slower than the hexagonal structure.

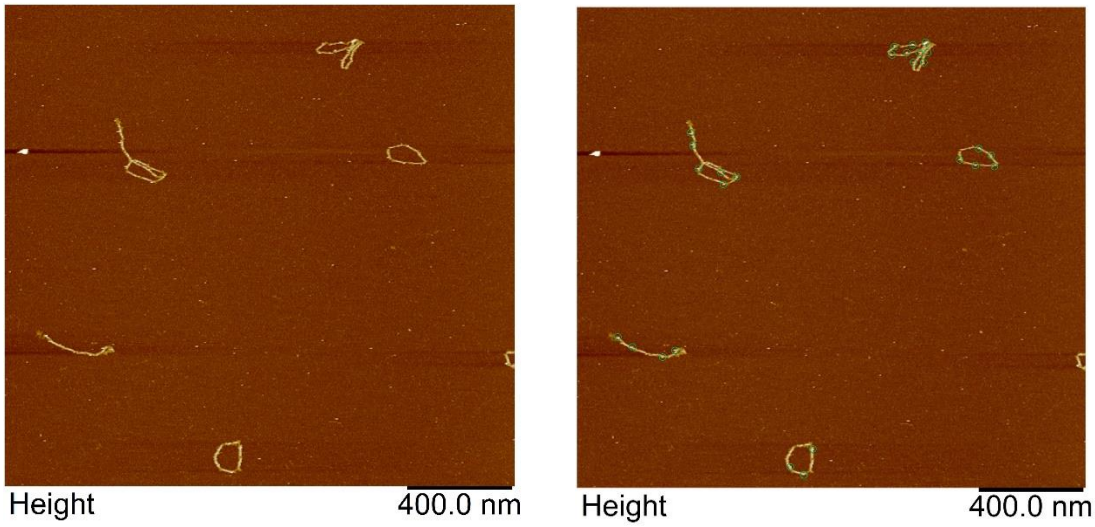

Figure 4. The hexagonal origami with gel purified results. There are seven origamis, two of them are shape changed. The possible biotin-streptavidins are marked with green dots. We counted all the possible dots on the seven origamis, manually.

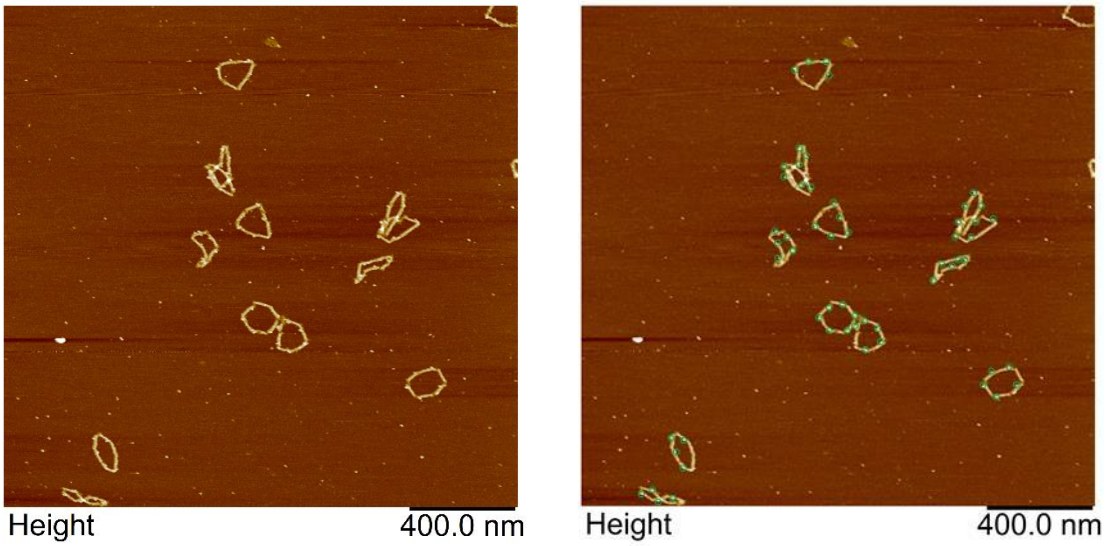

Figure 5. Purified results. There are 13 origamis, and possible biotin-streptavidins were marked with green dots.

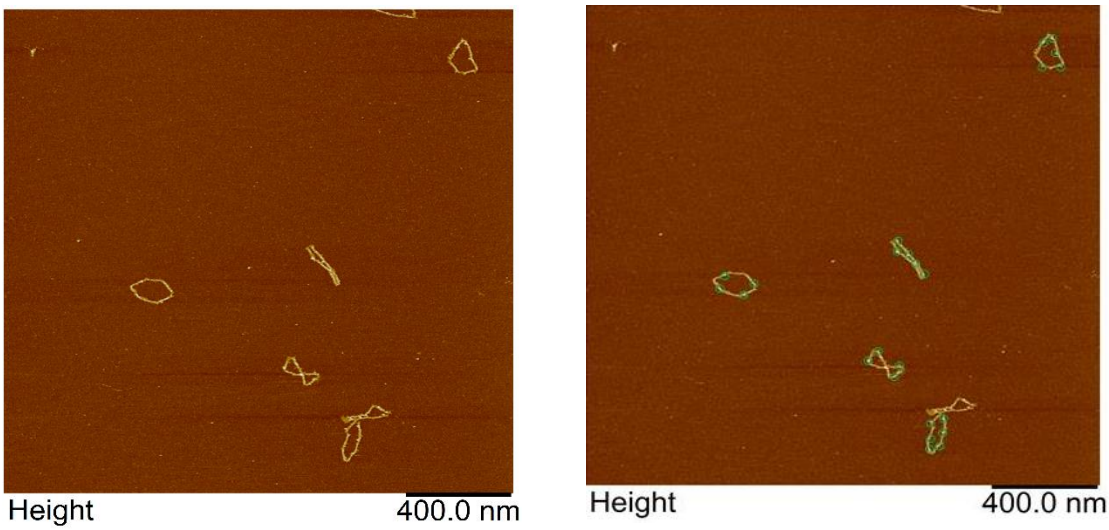

Figure 6. Purified results. There are six origamis, possible biotin-streptavidins are marked with green dots.

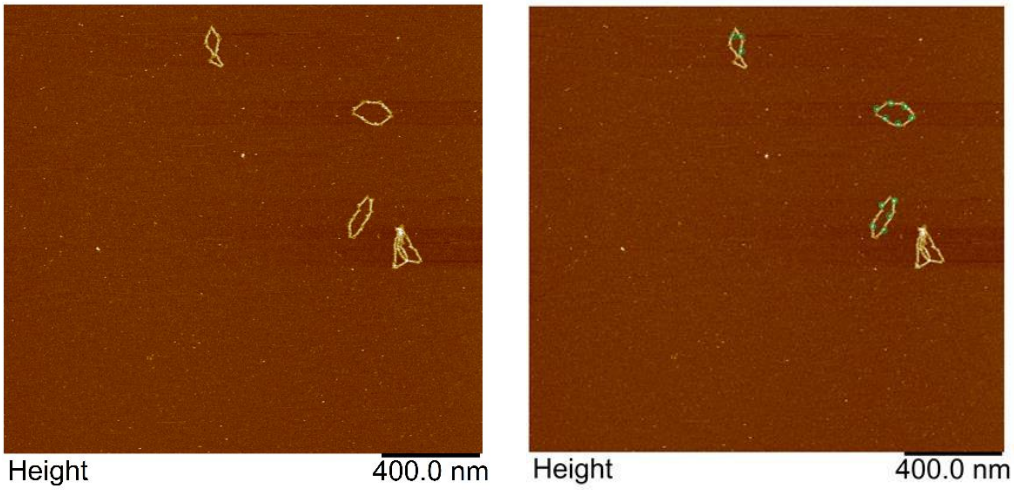

Figure 7. Purified results. There are five origamis, and we marked three of them.

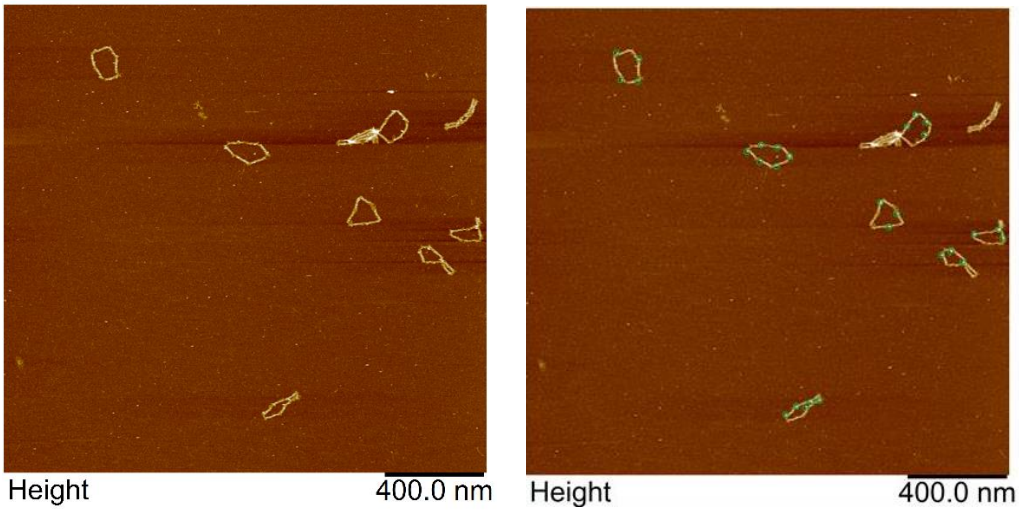

Figure 8. Purified results. There are ten origamis, we marked seven of them.

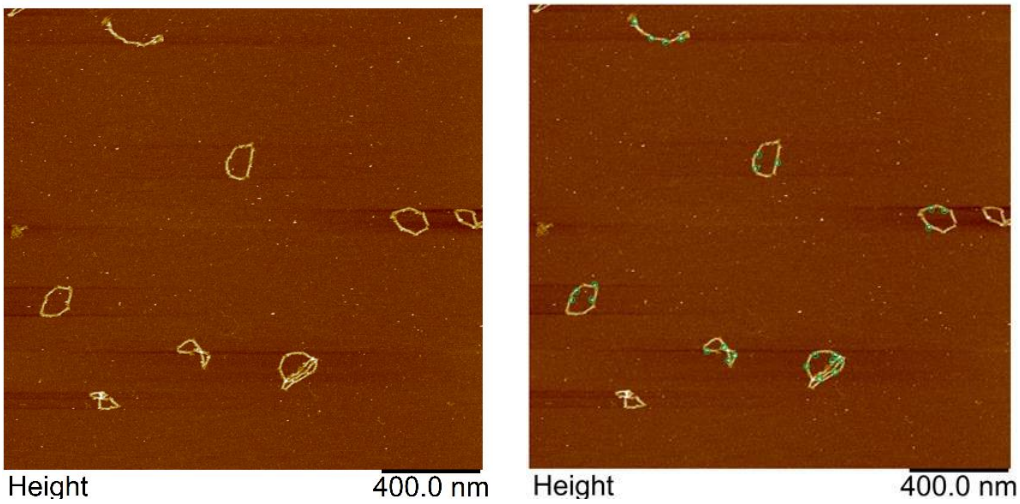

Figure 9. Purified results. There are nine origamis, one of them is shape changed.

The samples had attached labels in previous step. We suspect the labels could fall off from the structures. To identify the linking efficiency of biotin-streptavidin labels, we added excess streptavidin solution to the purified samples. The following results are the gel purified results with extra streptavidin solution.

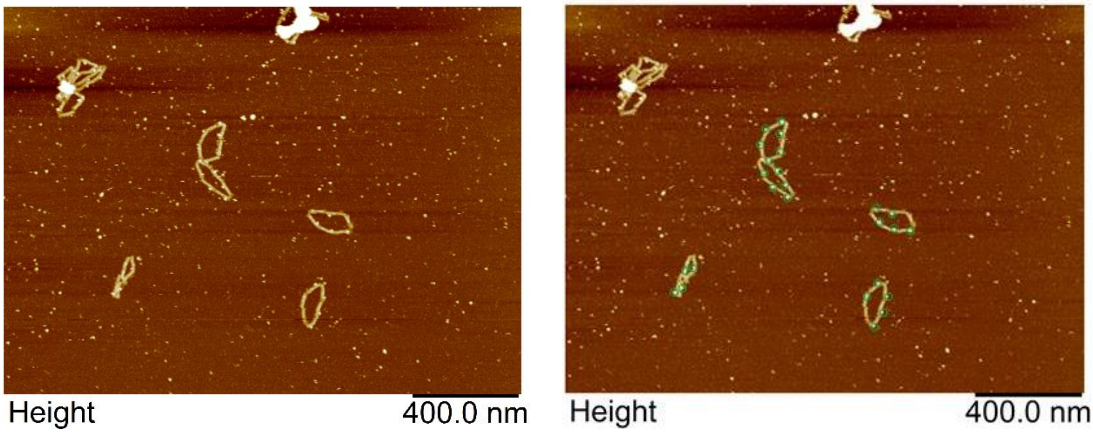

Figure 10. Purified results with extra streptavidin. Some origamis stacked together. We suspect they were stacked through the blunt end of these edges. These high white areas are the stacking positions.

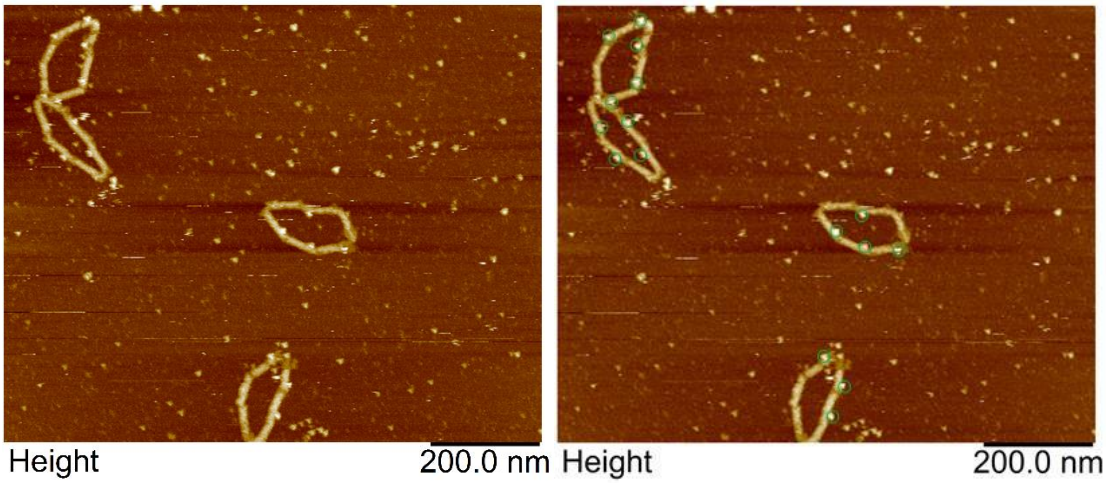

Figure 11. Purified results with excess streptavidin.

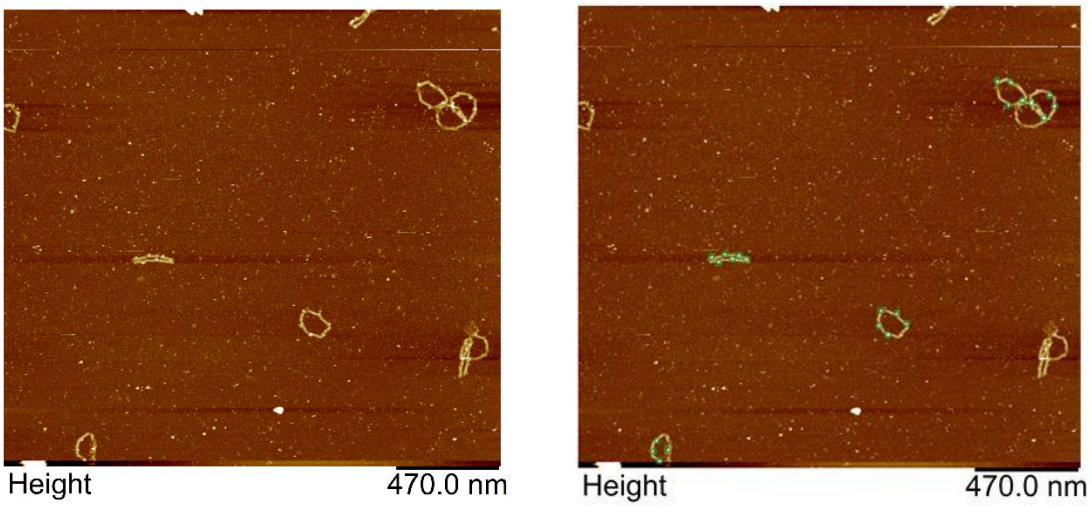

Figure 12. Purified results with excess streptavidin. There are nine origamis, one of them is shape changes. We marked 5 of them.

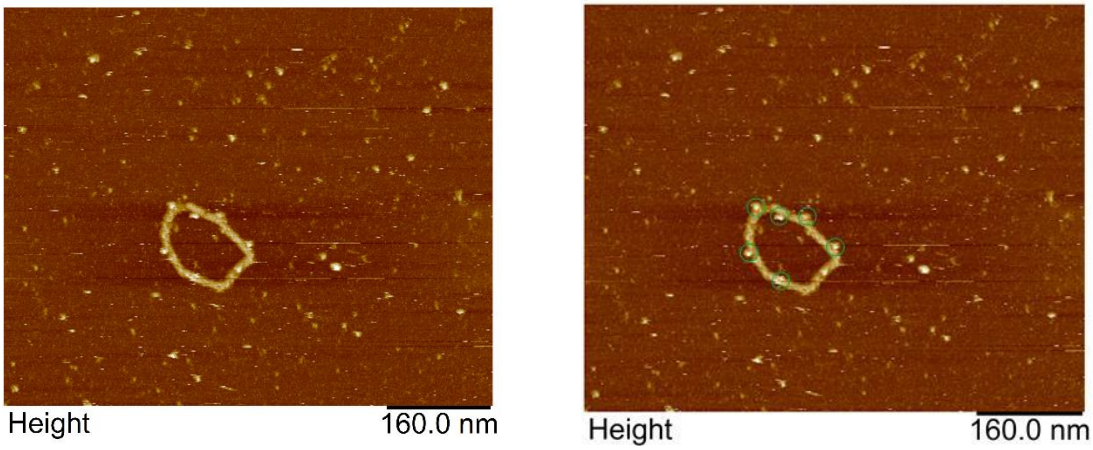

Figure 13. A typical hexagonal origami with biotin-streptavidin labels.

Yield statistics:

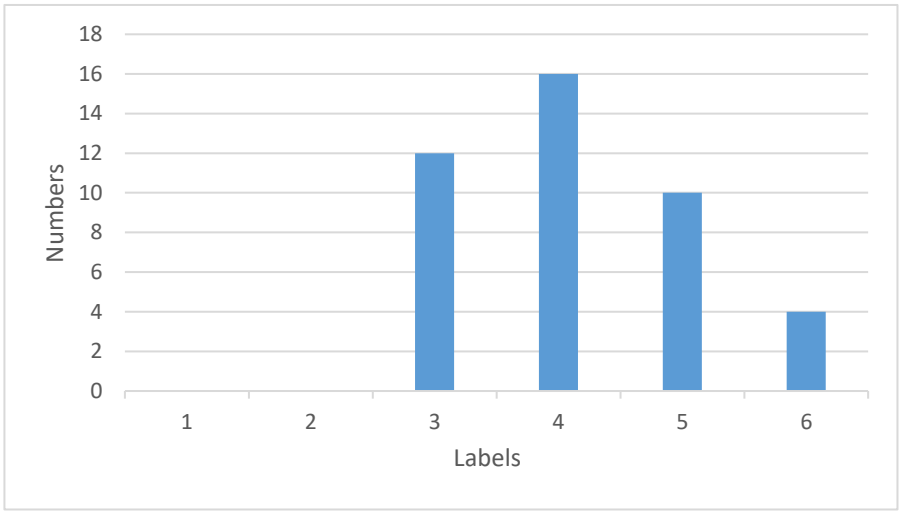

Figure 14. The statistical analysis of purified samples of biotin-streptavidin linking efficiency.

From the above Figures 3 to 8, we marked 42 origamis. There are four hexagonal origamis with six labels; Ten origamis with five labels; 16 origamis with four labels, 12 origamis with three labels. The total linking efficiency is approximately 70%.

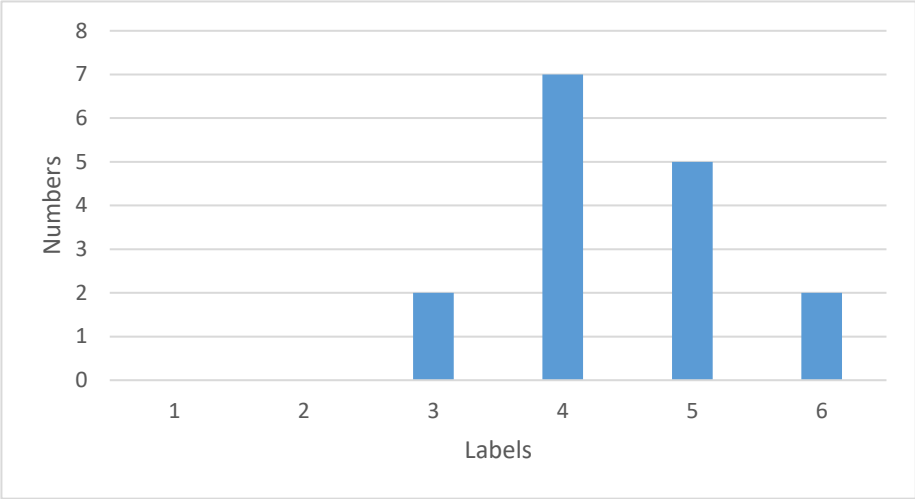

Figure 15. The statistical analysis of purified samples with extra streptavidin.

We marked 15 origamis in Figures 9 to 12. There are two hexagonal origamis with six labels; Five origamis with five labels; Seven origamis with four labels; One origami with Three labels. The total linking efficiency is approximately 75%.

Three defect structures were in linear shape. Some of the structures were randomly twisted together. The total number of the above-scanned original is 49; three among them are defects. Therefore, the ratio is 6%.

In conclusion, the linking efficiency is around 70%. There could be a slight deviation, as some labels are misidentified. The statistical results are reliable, because of the greater number of purification results; more images are not provided in this file, as limited by the length of supplementary files.

Lines with statistical analysis:

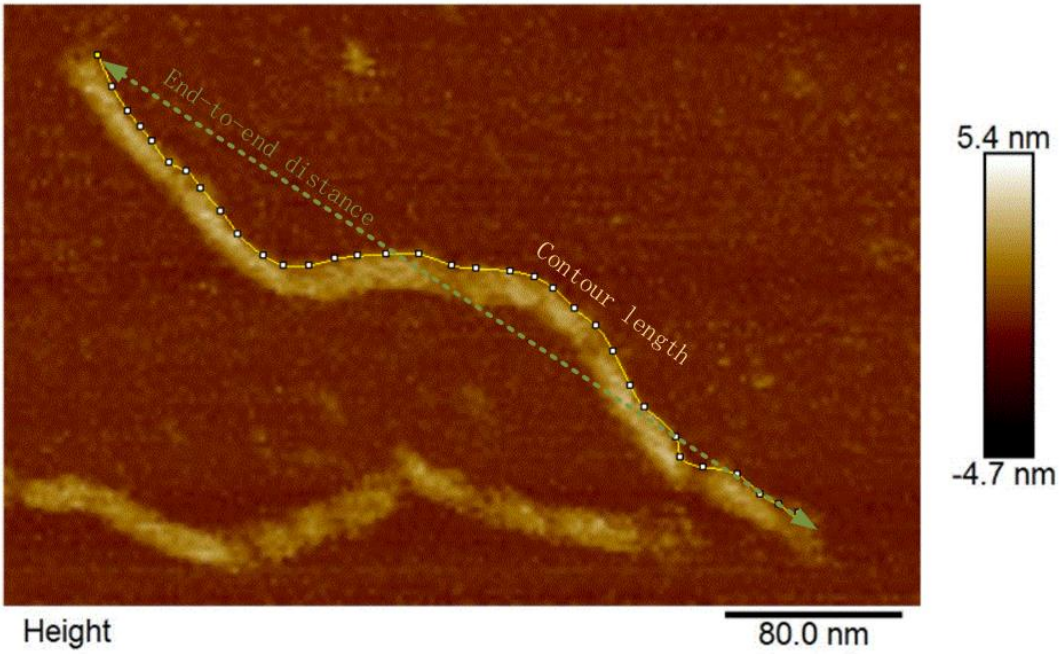

Figure 16. Analysis of a linear origami. The contour length and end-to-end distance were measured via ImageJ software. The contour length was 428.4nm, the end-to-end distance was 392nm.

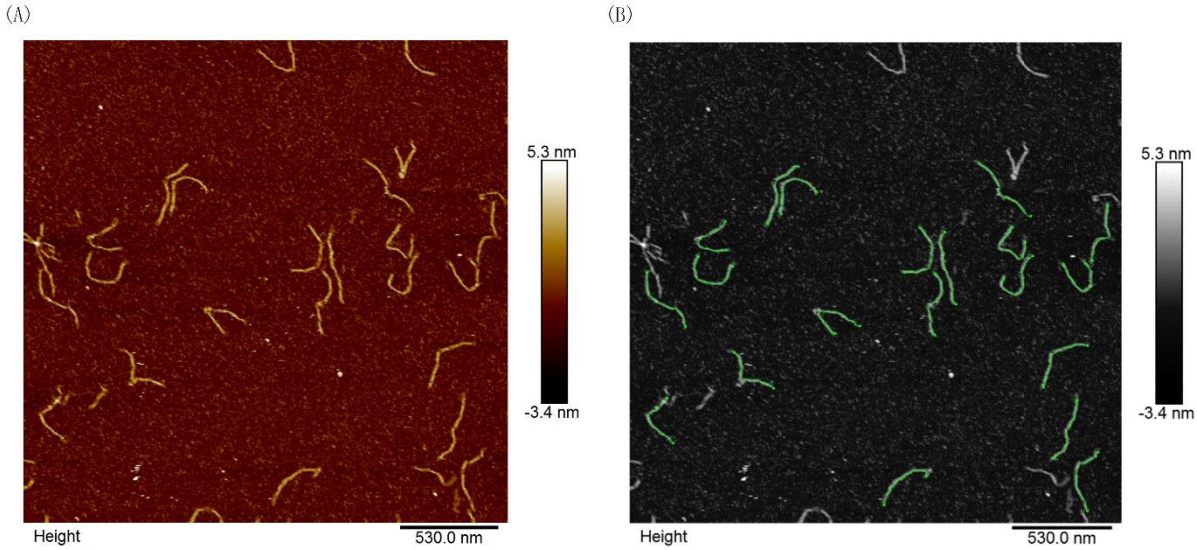

Figure 17. The linear origami analysis. (A) Original AFM image. (B) The green lines are the contour lines of selected origamis. The length of these green lines was calculated via ImageJ software.

We selected 20 origamis in figure 17(B) and measured their contour length and end-to-end distance via software. The results are illustrated in Table 2.

Table2 The contour length and end-to-end distance measurements.

PathID	PrimaryPath	PathLength	End-to-End Length	LengthUnits	Contour Length	End-to-End Length	LengthUnits
1	TRUE	2.8004	1.65645	inches	380.5672	225.10731	nm
2	TRUE	3.0081	2.68397941	inches	408.7931	364.74592	nm
3	TRUE	2.7632	1.12029128	inches	375.5118	152.24471	nm
4	TRUE	2.8935	1.39750329	inches	393.2192	189.91711	nm
5	TRUE	2.9944	1.07731306	inches	406.9313	146.40408	nm
6	TRUE	2.6272	2.20964671	inches	357.0297	300.28532	nm
7	TRUE	3.0999	2.60927957	inches	421.2685	354.5944	nm
8	TRUE	2.8618	2.56097834	inches	388.9113	348.03039	nm
9	TRUE	2.8355	1.89786004	inches	385.3372	257.91431	nm
10	TRUE	3.2439	2.91417492	inches	440.8377	396.0289	nm
11	TRUE	2.6998	2.19328547	inches	366.8959	298.06187	nm
12	TRUE	2.9839	2.37717019	inches	405.5044	323.05133	nm
13	TRUE	2.9481	1.44979062	inches	400.6392	197.02283	nm
14	TRUE	2.7418	2.45469609	inches	372.6036	333.5869	nm
15	TRUE	2.8046	0.84117055	inches	381.1379	114.31292	nm
16	TRUE	3.247	2.99891247	inches	441.259	407.54452	nm
17	TRUE	2.6503	1.81154803	inches	360.169	246.18473	nm
18	TRUE	2.7246	0.76439767	inches	370.2662	103.87968	nm
19	TRUE	3.055	2.50664455	inches	415.1667	340.64657	nm
20	TRUE	2.7092	2.34837547	inches	368.1733	319.13821	nm

We measured the selected 20 origamis. The mean square end-to-end distance of these linear origamis is 81826.74. The 2 dimensions equilibrium, formulation (1) was adopted to calculate the persistence length.[1]

$$< R^2 >_{2D} = 4L_p L(1 - \frac{2L_p}{L}(1 - e^{\frac{-L}{2L_p}})) \quad (1)$$

The $< R^2 >_{2D}$ is mean-square end-to-end distance that obtained from table2, L is the contour length, L_p is the persistence length.

We brought these twenty values of L and the constant value $< R^2 >_{2D}$ into formula (1) and calculated 20 times via MATLAB, respectively. And we got twenty

results. The average value of the twenty results (L_p) is 100, standard deviation is 18. Therefore, the persistence length is 100±18nm.

Annealing Process：

1. Folding the origami structures
95℃ to 85℃：-0.1℃ Every 8 sec
85℃ to 65℃：-0.1℃ Every 30 sec
65℃ to 45℃：-0.1℃ Every 40 sec
45℃ to 25℃：-0.1℃ Every 2 min
25℃ to 4℃：-0.1℃ Every 15 sec

2. Linking biotin strands
45℃ to 25℃：-1℃ Per min
25℃ to 4℃：-0.1℃ Every 8 sec

Reference:

[1] Mantelli S, Muller P, Harlepp S and Maaloum M 2011 Conformational analysis and estimation of the persistence length of DNA using atomic force microscopy in solution Soft Matter 7 3412

The DNA sequences:

The hexagonal origami:

35[210]33[223]	ATCACCCAAATCAATAACCAATAGGAACCCGTGCATCTGCCA
20[125]22[112]	AAAATCTACGTTAAGATAAAAACCAAAATGCAAAAGAAGTTT
11[42]9[55]	AGGGACATTCTGGCAAACCATCGATAGCACAAAAGGGCGACA
17[126]15[139]	CAGCCATTGCAACATTGCCATAATTGCGCTAAAGGCTTTTCA
7[154]11[167]	CCATATTATTTATCGAGCGCTAATATCACCTAAAACATCGCC

23[84]21[97] TTAGAATCAGAGCGATAGTAAAATGTTTCTATCATAACCCTC

31[196]35[209] CTGCAAGGCGATTACAAGCTTGCATGCCCCACTACGTGAACC

25[70]29[83] CTCATATATTTTAATCGGTTGTACCAAACTAAAGGGAGCCCC

30[55]32[42] TGCCTAATGAGTGATGCGTTGCGCTCACGAGAGAGTTGCAGC

18[181]20[168] ATGAACGGTGTACAGAGATTTGTATCATTAAAACGAAAGAGG

13[70]17[83] AGAACCGCCACCCTAGAGGGTTGATATAAGTAGAAGAACTCA

14[209]16[196] CCAGCATTGACAGGACCCTCAGAACCGCAGTTTGCCTTTAGC

4[111]0[98] GAACGCGCCTGTTTCTGAACCTCAAATATAACTATATGTAAA

16[69]12[56] TAATTGTATCGGTTACATCACTTGCCTGAGTATAGCCCGGAA

5[126]3[139] AATATCTGGTCAGTCGTAAAAACAACATACAATAACAGAAAT

25[196]29[209] AGTAGATTTAGTTTGGGGCGCGAGCTGACCACCACACCCGCC

1[112]5[125] CCGGAATCATAATTTAGGTTGGGTTATATCAAACCCTCAATC

23[168]21[181] TTATAATCAGTGAGCCATCGCCCACGCACAGCGAAAGACAGC

27[140]25[153] AAAAGATTAAGAGGCTCAACATGTTTTAGTACGGTGTCTGGA

14[83]16[70] GCATTCCACAGACAGGATTTTGCTAAACCCAAAAGGAGCCTT

31[70]35[83] TCGGGAAACCTGTCCCGGAAGCATAAAGAAACAATTCGACAA

27[56]25[69] CTGGAGCAAACAAGGGAGAGGGTAGCTAAAATTTTTAGAACC

35[84]33[97] CTCGTATTAAATCCATTTTGCGGAACAAAATCGGCAAAATCC

24[181]26[168] TTCTACTAATAGTATAACAGTTGATTCCAGCTTAATTGCTGA

4[153]0[140] CAAAATTATTTGCATGGCAAATCAACAGTGAGAGACTACCTT

29[126]27[139] AAGGAAGGGAAGAAAGCGGATGAAAAGCATAATCATGCATCA

34[153]30[140] ATGTGAGCGAGTAATTAAAGAACGTGGATCGTAATCATGGTC

18[55]20[42] CTGACGAGAAACACTTGGGCTTGAGATGTTAGGAATACCACA

13[154]17[167] GAATTTACCGTTCCAAAGTATTAAGAGGGGAAATACCTACAT

4[69]0[56] AAAATAATATCCCACTGAGAGCCAGCAGAGAACGCGAGAAAA

2[125]4[112] GTTTAGTATCATATCTGTCCAGACGACGGTTCAGCTAATGCA

31[154]35[167] GGGCCTCTTCGCTATACCGAGCTCGAATCTCCAACGTCAAAG

16[153]12[140] CCCCTTATTAGCGTGGAAAAACGCTCATCTGAGACTCCTCAA

22[111]18[98] TGCCAGAGGGGGTAGGAGCTAAACAGGATATTCATTACCCAA

0[181]2[168] AATAGTGAATTTATAACAGTACATAAATGCAAAAGAAGATGA

2[167]4[154] TGAAACAAACATCAGATTTTCAGGTTTAAGAACCTACCATAT

5[42]3[55] GCAACAGTGCCACGTCCTAATTTACGAGTAATTTAGGCAGAG

30[139]32[126] ATAGCTGTTTCCTGCGGTTTGGTTGGGACGCAACTCGTATTG

35[168]33[181] GGCGAAAAACCGTCTCCTGTAGCCAGCTGTAATGGGATAGGT

26[209]28[196] TAAGAGGTCATTTTAAAGCGAACCAGACAGTTCAGAAAACGA

26[83]28[70] GATAAATTAATGCCAGAATCGATGAACGAACGTTAATATTTT

22[195]18[182] GACAATGACAACAAGCCACCGAGTAAAATTGAAAGAGGACAG

2[83]4[70] GCCAACGCTCAACAGTAATAAGAGAATAAGTCCTGAACAAGA

0[223]2[210] GAAAACATAGCGATCTGTAAATCGTCGCACAAAATCGCGCAG

35[42]33[55] TTGAGGATTTAGAAATCATATTCCTGATTTTGCCCCAGCAGG

10[111]6[98] CAGCAAAATCACCAGTGGCACAGACAATGCAAGAAACAATGA

16[195]12[182] GTCAGACTGTAGCGGTCTGAAATGGATTATTTCGGAACCTAT

0[55]2[42] CTTTTTCAAATATACTTCTGACCTAAATAGAATCGCCATATT

26[237]24[224] AGAGAGTACCTTTATTTCGCAAATGGTCAATAACCTGTTTAG

32[167]34[154] GGCAAAGCGCCATTACGGCGGATTGACCTTCATCAACATTAA
34[195]30[182] TTCGCGTCTGGCCTTATCAGGCGATGGCTGCAGGTCGACTCT
33[98]31[111] CTTATAAATCAAAATTTTCTTTTCACCAAATGAATCGGCCAA
12[139]14[126] GAGAAGGATTAGGAGAACCCAAGAATGGTAAAGCCTGTACCG
21[56]19[69] GGAATTACGAGGCATCATCAGTTGAGATGTTTAATTTCAACT
19[196]23[209] TGTCGAAATCCGCGCGAACTGACCAACTGAGTCTGTCCATCA
15[56]13[69] GAATTTTCTGTATGGCCCTCATAGTTAGGAACCGCCACCCTC
21[140]19[153] GCCGCTTTTGCGGGAAAACACTCATCTTTATACCAAGCGCGA
9[56]7[69] TTCAACCGATTGAGTGTCACAATCAATAGCAATAATAACGGA
3[182]1[195] TACAGTAACAGTACTTTCAATTACCTGACAATATATGTGAGT
8[167]10[154] ACCAACGCTAACGAGCCCAATAGCAAGCGCACTCATCGAGAA
1[70]5[83] TACCGACCGTGTGACAATCGCAAGACAACAAATGAAAAATCT
25[154]29[167] AGTTTCATTCCATAGTAGCATTAACATCGCGCTAGGGCGCTG
19[154]23[167] AACAAAGTACAACGGACCAGGCGCATAGCCTGAGAAGTGTTT
27[182]25[195] TTAATTCGAGCTTCTGCGGATGGCTTAGCAATTCTGCGAACG
29[210]27[223] GCGCTTAATGCGCCCAAATGCTTTAAACCGGAAGCAAACTCC
12[223]14[210] CCGTATAAACAGTTGGTAATAAGTTTTACACCAGAGCCGCCG
9[182]7[195] AGGCTTATCCGGTAACCCAGCTACAATTAAACGATTTTTTGT
28[153]24[140] ATAGTCAGAAGCAAAGCGAAAGGAGCGGCAATAAATCATACA
6[223]8[210] AAGCGCATTAGACGGAAAATAGCAGCCTCTTAAATCAAGATT
19[70]23[83] TTAATCATTGTGAAGCTGCTCATTCAGTACGTGCTTTCCTCG
32[209]34[196] CTCCAGCCAGCTTTTGGGCGCATCGTAAGCCATCAAAAATAA
20[167]22[154] CAAAAGAATACACTATCGTCACCCTCAGTAACCGATATATTC
15[98]13[111] TCAGCGGAGTGAGAGTCACCAGTACAAATCATTTTCAGGGAT
32[83]34[70] AGCTGATTGCCCTTGATGGTGGTTCCGAAGAAACCACCAGAA
34[111]30[98] TGAGTAACATTATCTTTGCCCGAACGTTCCGCTCACAATTCC
21[182]19[195] ATCGGAACGAGGGTCGAAGGCACCAACCCGCCTGATAAATTG
9[98]7[111] ATTCATTAAAGGTGCATATAAAAGAAACCTCCTTATTACGCA
15[140]13[153] TAATCAAAATCACCAAATAAATCCTCATAAAGCGCAGTCTCT
15[182]13[195] CCCTCAGAGCCGCCAGGTTGAGGCAGGTATGGCTTTTGATGA
17[168]15[181] TTTGACGCTCAATCCGTTTTCATCGGCACACCGGAACCGCCT
7[196]11[209] TTAACGTCAAAAATGGAGAATTAACTGAGAAGATAAAACAGA
5[210]3[223] AGATTAGAGCCGTCAATTCATCAATATAGAAACAATAACGGA
33[182]31[195] CACGTTGGTGTAGACCGGCACCGCTTCTGAAAGGGGGATGTG
7[70]11[83] ATACCCAAAAGAACTCTTACCGAAGCCCCCCTTCTGACCTGA
23[126]21[139] ATTTTAGACAGGAAGCAGGGAAGGCTTTTAGCGAGGTTAAAG
25[112]29[125] AGATTCAAAAGGGTTTAGCAAAATTAAGCGAACGTGGCGAGA
20[209]22[196] ACGTAATGCCACTAAGCAACGGCTACAGCCGATAGTTGCGCC
0[139]2[126] TTTAACCTCCGGCTACTAGAATTAACAAATTACATAAAGCCT
28[195]24[182] GAATGACCATAAATCACGCTGCGCGTAAAAAGGTGGCATCAA
13[112]17[125] AGCAAGCCCAATAGTTAGCGGGGTTTTGAACAATATTACCGC
20[83]22[70] ACAGGTAGAAAGATTAGTAAGAGCAACAAGACTGGATAGCGT
14[167]16[154] TGATATTCACAAACGGAACCAGAGCCACTTTTCGGTCATAGC
24[139]26[126] GGCAAGGCAAAGAAGAGAAAGAACTAAAAATATGCGCCGGAG

23[210]21[223] CGCAAATTAACCGTTAAACAGCTTGATAAGGCTTTGAGGACT
15[224]17[237] CCACCCTCAGAGCCAGCACCGTAATCAGCGACCAGTAATAAA
17[210]15[223] ATTCACCAGTCACATAGCGACAGAATCACACCCTCAGAGCCA
27[98]25[111] AGCATGTCAATCATATCAATATGATATTTAATGTGTAGGTAA
11[210]9[223] GGTGAGGCGGTCAGTCAATAATCGGCTGGGCGTTTTAGCGAA
18[97]20[84] ATCAACGTAACAAATTACCTTATGCGATGGAACAACATTATT
26[167]28[154] ATATAATGCTGTAGAAGCCCGAAAGACTTTACCCTGACTATT
28[111]24[98] GATTGTATAAGCAAACGGGGAAAGCCGGCAATAAAGCCTCAG
24[55]26[42] GTAATACTTTTGCGCAACGCAAGGATAATTTTTGAGAGATCT
1[196]5[209] GAATAACCTTGCTTAGCTTAGATTAAGACACTAACAACTAAT
11[168]9[181] ATTAAAAATACCGATTAAACCAAGTACCAAATCAGATATAGA
29[168]27[181] GCAAGTGTAGCGGTCAAAAATCAGGTCTTCAAATATCGCGTT
21[98]19[111] GTTTACCAGACGACTAAAACGAACTAACTTTAAGAACTGGCT
20[237]18[224] GAGGAAGTTTCCATACTTAGCCGGAACGAGGCGCAGACGGTC
31[112]35[125] CGCGCGGGGAGAGGTGTGAAATTGTTATATTAATTTTTTGGA
16[111]12[98] CACGTTGAAAATCTCTGGTAATATCCAGCTCAGTACCAGGCG
17[84]15[97] AACTATCGGCCTTGCCAAAAAAAAGGCTAACTTTCAACAGTT
12[55]14[42] TAGGTGTATCACCGTACCGCCACCCTCACGTAACGATCTAAA
18[139]20[126] ATCAAGAGTAATCTGGACGTTCAGCGATTGACCCCGGGAAGA
35[126]33[139] ACAAGAGTCCACTACAACCCGAGTGTTGAGGGTTGTCGGATT
24[223]26[210] CTATATTTTCATTTGACCATTAGATACAATTGCTCCTTTTGA
28[69]24[56] GTTAAAATTCGCATACTAAATCGGAACCAACATTATGACCCT
2[209]4[196] AGGCGAATTATTCACTTTTACATCGGGAATCCTGATTGTTTG
11[84]9[97] AAGCGTAAGAATACGTAGCACCATTACCTATTGACGGAAATT
33[56]31[69] CGAAAATCCTGTTTCACCGCCTGGCCCTTGCCCGCTTTCCAG
22[153]18[140] GGTCGCTGAGGCTTCGGTACGCCAGAATGCTGGCTGACCTTC
30[181]32[168] AGAGGATCCCCGGGTTACGCCAGCTGGCGGTGCCGGAAACCA
32[125]34[112] GGCGCCAGGGTGGTGAATAGCCCGAGATTTCCAGTAAAAGTT
3[224]5[237] TTCGCCTGATTGCTTATCAGATGATGGCAATAGATAATACAT
8[125]10[112] CATAAAGGTGGCAAAATTATCACCGTCATTGGGAATTAGAGC
4[195]0[182] GATTATACTTCTGAAATATCTTTAGGAGCGCTGAGAAGAGTC
6[139]8[126] AAGAATTGAGTTAAGTAGAAATGCCAGTCCTAATTATACATA
18[223]20[210] AATCATAAGGGAACACCTGCTCCATGTTTAAACGGGTAAAAT
19[112]23[125] CATTATACCAGTCATGACAAGAACCGGAGGCCGATTAAAGGG
2[237]0[224] TTGAATACCAAGTTTATTAATTAATTTTCCCTTAGAATCCTT
1[154]5[167] CCTTTTTTAATGGACAAAATCATAGGTCTTGAAAGGAATTGA
12[181]14[168] TATTCTGAAACATGAGTAAGCGTCATACCAGACGATTGGCCT
9[140]7[153] GGAATCATTACCGCGCGTCTTTCCAGAGTACAAAATAAACAG
6[181]8[168] GTCAGAGGGTAATTCCAATCCAAATAAGTTATCCTGAATCTT
3[56]1[69] GCATTTTCGAGCCAGTAGGGCTTAATTGTTAATGGTTTGAAA
32[237]30[224] CGACAGTATCGGCCAGGGTTTTCCCAGTCACGACGTTGTAAA
23[42]21[55] ACTATGGTTGCTTTTCGTCATAAATATTACATAACGCCAAAA
30[223]32[210] ACGACGGCCAGTGCAGTTGGGTAACGCCTCAGGAAGATCGCA
26[125]28[112] ACAGTCAAATCACCATGTACCCCGGTTGCCCAAAAACAGGAA

29[42]27[55]	AGGTGCCGTAAAGCTAAATTTTTGTTAACATTGCCTGAGAGT
10[69]6[56]	AAACGTCACCAATGCAACAGAGATAGAATTTTTAAGAAAAGT
7[112]11[125]	GTATGTTAGCAAACGCCCAATAATAAGAATTTTTGAATGGCT
8[209]10[196]	AGTTGCTATTTTGCTTCTAAGAACGCGATCTTTCCTTATCAT
33[224]35[237]	GTTTGAGGGGACGAATCAGCTCATTTTTGTTTTTTGGGGTCG
34[69]30[56]	GGAGCGGAATTATCGTATTAGACTTTACTGTAAAGCCTGGGG
5[84]3[97]	AAAGCATCACCTTGATCAACAATAGATATAAAGTACCGACAA
6[55]8[42]	AAGCAGATAGCCGAGAAACCGAGGAAACGAAAATTCATATGG
17[42]15[55]	TTTGATTAGTAATATATCAGCTTGCTTTAGACGTTAGTAAAT
8[83]10[70]	GAATAAGTTTATTTGGAGGGAAGGTAAAATTAGCAAGGCCGG
9[224]11[237]	CCTCCCGACTTGCGCATGTAGAAACCAATATTAACACCGCCT
27[224]29[237]	AACAGGTCAGGATTCATTGAATCCCCCTGCTACAGGGCGCGT
8[237]6[224]	GGAGGTTTTGAAGCTTACAGAGAGAATAACATAAAAACAGGG
10[153]6[140]	CAAGCAAGCCGTTTCGCGAACTGATAGCGAGAGATAACCCAC
11[126]9[139]	ATTAGTCTTTAATGTTATTTTGAGCCATCCGACTTCATCGTA
33[140]31[153]	CTCCGTGGGAACAACGCCATTCAGGCTGAGGGCGATCGGTGC
21[224]23[237]	AAAGACTTTTTCATCGAGGTGAATTTCTTGTAGCAATACTTC
3[140]1[153]	AAAGAAATTGCGTAAGAAAACAAAATTATTTCATTTGAATTA
3[98]1[111]	AAGGTAAAGTAATTGCGTTATACAAATTAATAAGAATAAACA
14[237]12[224]	GCCACCAGAACCACACGGGGTCAGTGCCTTGAGTAACAGTGC
5[168]3[181]	GGAAGGTTATCTAAATAATGGAAGGGTTACGTCAGATGAATA
14[125]16[112]	TAACACTGAGTTTCATAGAAAGGAACAAAATAATAATTTTTT
13[196]17[209]	TACAGGAGTGTACTAATGCCCCCTGCCTATTTACATTGGCAG
10[195]6[182]	TCCAAGAACGGGTAACGAACCACCAGCAACACCCTGAACAAA
22[69]18[56]	CCAATACTGCGGAAGACGAGCACGTATAGAATAAGGCTTGCC

The linear origami:

6[139]8[126]	TATCTTACCGAAGCAAACGCAATTTTTTAGAAACGAAGACAC
17[126]15[139]	TTAAAAATACCGAATCACCGGAACTAAAAAGGAACAACCAGA
0[55]2[42]	AAATAAGAATAAACACCGGAATCATAATATATAAAGTACCGA
17[210]15[223]	TGAGAGCCAGCAGCTTAGCGTCAGACTGGAGCCGCCACCAGA
1[196]5[209]	GCTGAGAAGAGTCAAGGTTGGGTTATATATTATACTTCTGAA
23[126]21[139]	TTTGACGCTCAATCTGAGGCTCCCTCGTATCATAATGCAGGG
15[182]13[195]	ACCGCCACCCTCAGGGCCTTGATATTCAGTACTGGTAATAAG
4[153]0[140]	TTTTACATCGGGAGTCATATTCCTGATTGAACGCGAGAAAAC
8[167]10[154]	AGCCATATTATTTAGAGGCGTTTTAGCGGCGCCCAATAGCAA
19[196]23[209]	ATAAATTGTGTCGAAAGGGAACCGAACTAGGGACATTCTGGC
15[98]13[111]	TCAACAGTTTCAGCGTACAAACTACAACCAGGGATAGCAAGC
32[209]34[196]	TGGGCGCATCGTAACAACCCGTCGGATTAACGTTAATATTTT
33[56]31[69]	GTTTTTCTTTTCACAACGCGCGGGGAGAACACAACATACGAG
5[126]3[139]	GAGCGGAATTATCAAAACAATCTGAACAATAAGTCAACGGAT
11[84]9[97]	TATCTGGTCAGTTGGGCCGGAAACGTCAAAGGTGAATTATCA
29[210]27[223]	AACATCACTTGCCTATACTGCGGAATCGAATATCGCGTTTTA
0[139]2[126]	TTTTTCAAATATATAGTAGGGCGTCGCTTGTAAATCTTAATT

14[83]16[70] ACAGACAGCCCTCATTCTGTATGGGATTAAAAAGGCTCCAAA

5[42]3[55] GTATTAAATCCTTTCATTCCAAGAACGGCAAAAGGTAAAGTA

16[153]12[140] TTTCATAATCAAAACGAACCACCAGCAGTAGGATTAGCGGGG

19[112]23[125] CTTATGCGATTTTAAGTAATCTTGACAAGGAAATACCTACAT

25[154]29[167] AACATGTTTTAAATGCGCGAGCTGAAAAAGAGTCTGTCCATC

4[111]0[98] CCATCCTAATTTACTTTTGCGGAACAAATCTTCTGACCTAAA

9[140]7[153] TATTCTAAGAACGCTCCCAATCCAAATAGTTTAACGTCAAAA

25[70]29[83] ATACTTTTGCGGGAGCAAAATTAAGCAAAGGCCGATTAAAGG

30[139]32[126] CAAGCTTGCATGCCATTGCGTCAGCTTTCTCCAGCTGCGCTC

9[182]7[195] CGGGAGGTTTTGAAAGCCTAATTTGCCATAACATAAAAACAG

12[181]14[168] AGAGGCTGAGACTCGATGATACAGGAGTCAAACAAATAAATC

20[83]22[70] ACGAACTAACGGAAACTAATGCAGATACCAAAAGAAGTTTTG

9[98]7[111] CCGTCACCGACTTGATTTTGTCACAATCCATACATAAAGGTG

14[167]16[154] CTCATTAAAGCCAGCGCCTCCCTCAGAGAGCGTTTGCCATCT

3[182]1[195] GGCGAATTATTCATCTTTTTTAATGGAAGCTTAGATTAAGAC

5[168]3[181] ATTCATCAATATAACGTCAGATGAATATCAAAATCGCGCAGA

27[224]29[237] ATTCGAGCTTCAAACTGGATAGCGTCCAGAGTAGAAGAACTC

7[112]11[125] GCAACATATAAAAGCCTTTTTAAGAAAAGAAAGGAATTGAGG

27[98]25[111] CAAAGGCTATCAGGAATGTGTAGGTAAAAACGCAAGGATAAA

33[98]31[111] TTCACCGCCTGGCCAGTCGGGAAACCTGTGCCTAATGAGTGA

14[125]16[112] GAGTTTCGTCACCAGGAGTGAGAATAGAGGAATTGCGAATAA

28[111]24[98] GGTAATCGTAAAACACGGTACGCCAGAATAAATCATACAGGC

0[181]2[168] GCTGATGCAAATCCAAAACATAGCGATAACAGTACATAAATC

24[223]26[210] CATTAGATACATTTCAGTTGATTCCCAAAAGCAAACTCCAAC

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34[111]30[98] CAGGCGAAAATCCTGACTCCAACGTCAAAGAGGATCCCCGGG

7[154]11[167] ATGAAAATAGCAGCGAGCAAGAAACAATCTAACAACTAATAG

11[210]9[223] ATTAGACTTTACAACCGCACTCATCGAGTTAGTTGCTATTTT

23[84]21[97] CAGCCATTGCAACAGCGAGAGGCTTTTGATAACGCCAAAAGG

9[56]7[69] GGTAAATATTGACGCCAAAGACAAAAGGAAGACTCCTTATTA

12[139]14[126] TTTTGCTCAGTACCTGTACCGATTTACCTCTCTGATAACACT

12[55]14[42] GGTTTAGTACCGCCACCCTCAGAACCGCATCTAAAGTTTTGT

32[237]30[224] GTAATGGGATAGGTGGGCCTCTTCGCTATTACGCCAGCTGGC

26[237]24[224] GCGAACCAGACCGGTTCTGCGAACGAGTAGATTTAGTTTGAC

1[70]5[83] TGTTTAGTATCATAATACCGACCGTGTGAATTTTAAAAGTTT

28[153]24[140] TGACCATAAATCAAGGCCACCGAGTAAAGGTGGCATCAATTC

5[210]3[223] TAATGGAAGGGTTAGTAAAACAGAAATACAAAAGAAGATGAT

20[209]22[196] GGTAAAATACGTAAACGAGGGTAGCAACGCTTGATACCGATA

23[168]21[181] ATTCACCAGTCACAGACAACAACCATCGACCCTCAGCAGCGA

8[237]6[224] TTTTATCCTGAATCGAACACCCTGAACAAAGTCAGAGGGTAA

3[56]1[69] ATTCTGTCCAGACGCCAGTAATAAGAGATACTAGAAAAAGCC

22[153]18[140] ATATATTCGGTCGCGTCTGAAATGGATTGCGCATAGGCTGGC

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0[223]2[210] TTAACCTCCGGCTTATAGTGAATTTATCTTACATTTAACAAT

31[196]35[209] CGCAACTGTTGGGACTGCAAGGCGATTAGTACTATGGTTGCT
0[97]2[84] TTTAATGGTTTGAATGCGTTATACAAATATGTAATTTAGGCA
27[182]25[195] AGATTAAGAGGAAGGAGTACCTTTAATTCGGTGTCTGGAAGT
5[84]3[97] GAGTAACATTATCAGAGCATGTAGAAACCATGTTCAGCTAAT
26[167]28[154] GAGGTCATTTTTGCGTCAGAAGCAAAGCTCAGAAAACGAGAA
17[84]15[97] TTAGTCTTTAATGCTGAAAATCTCCAAATTGCTAAACAACTT
19[154]23[167] AAGCGCGAAACAAAGGTGTACAGACCAGATTTACATTGGCAG
2[209]4[196] TTCATTTGAATTACTTCAATTACCTGAGAAGAAATTGCGTAG
34[69]30[56] ATCCCTTATAAATCGTTGTTCCAGTTTGATAGCTGTTTCCTG
18[139]20[126] TGACCTTCATCAAGAGAACTGTTGACCCCTCATCTGCTCATT
8[125]10[112] CACGGAATAAGTTTAGCCATTTGGGAATTCACCAGTAGCACC
35[168]33[181] CCGCGCTTAATGCGTAAATTTTTGTTAATTCATCAACATTAA
14[209]16[196] CAGGTCAGACGATTAGCCACCACCCTCATAGCGCGTTTTCAT
30[223]32[210] GAAAGGGGGATGTGAGGGCGATCGGTGCCACGTTGGTGTAGA
26[83]28[70] AGAAAGGCCGGAGAGAGAGGGTAGCTATTATGTACCCCGGTT
33[182]31[195] ATGTGAGCGAGTAACCGTGCATCTGCCACGCCATTCAGGCTG
25[112]29[125] AATTTTTAGAACCCGCATTAACATCCAATCCTGAGAAGTGTT
30[181]32[168] AGGGTTTTCCCAGTGGCAAAGCGCCATTGTTTGAGGGGACGA
28[69]24[56] GATAATCAGAAAAGGGGAGCTAAACAGGTAAAGCCTCAGAGC
7[196]11[209] GGAAGCGCATTAGACAGAGAGATAACCCGAGGATTTAGAAGT
11[168]9[181] ATTAGAGCCGTCAATAGGAATCATTACCAACCTCCCGACTTG
15[224]17[237] ACCACCACCAGAGCAATCAAGTTTGCCTAAATGAAAAATCTA
29[84]27[97] GATTTTAGACAGGATAGCATGTCAATCATTTTGAGAGATCTA
31[154]35[167] GGTGCCGGAAACCACACGACGTTGTAAAAACCACCACACCCG
8[83]10[70] ATGGTTTACCAGCGGAAATTATTCATTACCAATGAAACCATC
3[98]1[111] GCAGAACGCGCCTGTTAACAACGCCAACTCTTACCAGTATAA
33[140]31[153] TTCGCGTCTGGCCTTCAGGAAGATCGCACCGGCACCGCTTCT
1[112]5[125] AGCCAACGCTCAACTTTAGTTAATTTCAGAAACCACCAGAAG
23[42]21[55] AACTATCGGCCTTGAGTAAAATGTTTAGCAGTTGAGATTTAG
16[195]12[182] CGGCATTTTCGGTCATTAACACCGCCTGACATGAAAGTATTA
21[182]19[195] AAGACAGCATCGGATGCCACTACGAAGGTGTATCATCGCCTG
19[70]23[83] GCTTGAGATGGTTTGTAACAAAGCTGCTAACAATATTACCGC
34[153]30[140] TAACCAATAGGAACGTCACGCTGCGCGTACGACGGCCAGTGC
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2[167]4[154] AATATATGTGAGTGTGAATACCAAGTTAACAGTAACAGTACC
1[154]5[167] CCTTAGAATCCTTGAATCGCAAGACAAAATCAGATGATGGCA
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12[97]14[84] ATATAAGTATAGCCACCACCCTCATTTTGCCTGTAGCATTCC
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3[140]1[153] TCGCCTGATTGCTTAATAACCTTGCTTCATTAATTAATTTTC
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18[55]20[42] GGCTTGCCCTGACGAGAAACACCAGAACGTAGAAAGATTCAT
10[153]6[140] GCAAATCAGATATATATCTTTAGGAGCAGAAATAGCAATAGC
4[195]0[182] ATTTTCAGGTTTAATCCTGATTGTTTGGAACTATATGTAAAT

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10[111]6[98] ATTACCATTAGCAAGCAAATCAACAGTTGTAAGCAGATAGCC

14[237]12[224] CGCCGCCAGCATTGAGTGCCCGTATAAACAGTTAATGCCCCC

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21[56]19[69] GAATACCACATTCACAACATTATTACAGGAGTAGTAAATTGG

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32[125]34[112] ACTGCCCGCTTTCCCTGAGAGAGTTGCACTGGTTTGCCCCAG

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24[55]26[42] ATAAAGCTAAATCGGTTGTACCAAAAACTCAATATGATATTC

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6[55]8[42] CGGAATACCCAAAAGAACTGGCATGATTGCGACATTCAACCG

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32[83]34[70] TTAATGAATCGGCCCAGTGAGACGGGCACCGAAATCGGCAAA

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21[224]23[237] TGAGGACTAAAGACCTTGCTTTCGAGGTCCCTTCTGACCTGA

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29[126]27[139] TTTATAATCAGTGAAAATCAGCAAACAATCTGGAGGTCTTTA

26[209]28[196] AGGTCAGGATTAGACCCGAAAGACTTCATCATAAATATTCAT

17[42]15[55] AGCGTAAGAATACGGTATCGGTTTATCACGTCTTTCCAGACG

13[196]17[209] TTTTAACGGGGTCACCTATTATTCTGAACAACAGTGCCACGC

13[112]17[125] CCAATAGGAACCCAAGGCGGATAAGTGCCTAAAACATCGCCA

25[196]29[209] TTCATTCCATATAACGCAAATGGTCAATCTTTGATTAGTAAT

11[42]9[55] AGCATCACCTTGCTAATCAGTAGCGACAATTGAGGGAGGGAA

4[69]0[56] CTGTCTTTCCTTATGCCCGAACGTTATTATAAATAAGGCGTT

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18[181]20[168] GAGGACAGATGAACGTACAACGGAGATTCACCAACCTAAAAC

7[70]11[83] CGCAGTATGTTAGCGAAGGAAACCGAGGAAACCCTCAATCAA

30[97]32[84] TACCGAGCTCGAATTGTAAAGCCTGGGGTCGTGCCAGCTGCA

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31[112]35[125] GCTAACTCACATTATGCAGGTCGACTCTAGGGCGAAAAACCG

10[69]6[56] GATAGCAGCACCGTGAACCTCAAATATCAAACGCAATAATAA

9[224]11[237] GCACCCAGCTACAATATTAAACCAAGTAACAATTCGACAACT