Electronic Supplementary Information

Direct observation of the dual-switching behaviors corresponding to the state transition in a DNA nanoframe

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Materials and Methods

Materials. All the staple DNAs for the DNA frame were purchased from Sigma Genosys (Hokkaido, Japan). Single stranded M13mp18 viral DNA was purchased from New England Biolabs, Inc. The DNA strands of the three double-stranded DNA including oligonucleotides containing G-repeats overhangs for incorporation into the DNA nanoframe were purchased from Japan Bio Services (Saitama, Japan).

Oligonucleotides containing photoresponsive domain. The photoresponsive ODNs used in here were the same as the previous reported method.[1]

Preparation of the DNA nanoframe. The DNA nanoframe was assembled in a 20 μL solution containing10 nM M13mp18 single-stranded DNA (New England Biolabs), 50 nM staple strands (5 eq), 20 mM Tris buffer (pH 7.6), 1 mM EDTA, and 10 mM $MgCl_2$ as following the previous study.[2] The mixture was annealed from 85 ^oC to 15 ^oC at a rate of -0.5 ^oC/min.

Introduction of three dsDNAs (dsAB, dsCD and dsEF) containing photo-responsive domain or G-telomeric repeats into the DNA nanoframe. The preassembled dsDNAs containing photoresponsive domains [20 nM (two equiv)] or G-telomeric repeats were incorporate into the DNA nanoframe (10 nM) by heating at 40 ^oC and then cooling to 15 ^oC at a rate of -0.1 ^oC/min using a thermal cycler. The sample was purified using gel-filtration (GE sephacryl-300). The assembled structures were observed by AFM, and the yield of incorporation was counted.

Photoirradiation to the dsDNA-attached DNA nanoframe. Photoirradiation for the sample was performed using Xe-lamp (300 W, Ashahi-spectra MAX-303) with band-path filter (10 nm FWHM); 350 nm and 450 nm for UV-light and visible-light, respectively. The sample containing 10 nM dsDNA-attached DNA frame (~2 nM), 20 mM Tris-HCl (pH 7.6), 10 mM $MgCl_2$ was irradiated at 35 ^oC for 10 min for UV-light.

High-speed AFM imaging of the dsDNAs in the DNA frame. High-speed AFM images were obtained on a high-speed AFM (Nano Live Vision, RIBM, Tsukuba, Japan) using a silicon nitride cantilever (Olympus BL-AC10EGS). The sample (2 μL) was absorbed on a freshly cleaved mica plate for 5 min at room temperature, and then washed with the buffer solution for the observation of single photo-switching directly. Scanning was performed in the same buffer solution using a tapping mode. Photoirradiation was carried out on the AFM stage (Olympus IX70 microscope) using a Hg-lamp light source (Olympus U-RFL-T) with band-path filters (330-380 nm for UV irradiation and 440-470 nm for visible light irradiation).

Table 1. Sequences of oligonucleotides containing photo-responsive domain and G-tracts.

	Sequence (5'-3')
AB64 (96mer)	**TAATAAAACGAACTAA**GGAGACTCTAGAGTGTTCCTGATGGCCGTGAATTCAAGGCGGTGGGTGCGCGTTGCTCCTCACT**CTCCCGACTTGCGGGA**
AB64-2 (32mer)	AGTGAGGAGCAACGCGCACCCACCGCCTTGAA
AB64-3-SS (32mer)	**SS**-TTCACGGCCATCAGGAACACTCTAGAGTCTCC
CD64 (96mer)	**ATGAGCTTAATTGCTA**AGTGAGGAGCAACGCGCACCCACCGCCTTGAATTCACGGCCATCAGGAACACTCTAGAGTCTCC**AAATAAGGCGTTAAAT**
CD64-GQ-1 (44mer)	GGAGACTCTAGAGTGTTCCTGATGGCCGTGAA**TTTGGGTTAGGG**
CD64-3-SS (32mer)	**SS—**TTCAAGGCGGTGGGTGCGCGTTGCTCCTCACT
EF74 (106mer)	**CTATTTTTGAGAGATC**GCTCGAGTAGCTCATCTGGGCGTAGTACCATCACGTAATCCGGTACGAGAGACCAGGTCCGTGCCGTGAGGAGG**ACGTCAGATGAATATA**
EF74-compl (37mer)	CCTCCTCACGGCACGGACCTGGTCTCTCGTACCGGAT
EF74-GQ-2 (49mer)	**GGGTTAGGGTTT**TACGTGATGGTACTACGCCCAGATGAGCTACTCGAGC
Azo-3X-SS (13mer)	CGTXTAXGTXTCA-**SS**
Azo-4X-SS (14mer)	TGXAAXCTXAAXCG-**SS**
AB64-X3 (45mer)	CGTXTAXGTXTCA-**SS**-TTCACGGCCATCAGGAACACTCTAGAGTCTCC
CD64-X4 (46mer)	TGXAAXCTXAAXCG-**SS**-TTCAAGGCGGTGGGTGCGCGTTGCTCCTCACT

Underlined bold sequences represent complementary sequences to the connection sites in the DNA nanoframe for hybridization. In the AB64-3-SS and CD64-3-SS, disulfide modified linker (SS) was introduced to the end of 5' terminals, which are marked with blue color in the table. Also disulfide modified linker was introduced to the 3' terminal of Azo-3X-SS and Azo-4X-SS. The red X is representing that the azobenzene molecules were tethered into the oligonucleotides.

Table S2. Formation ratio of DNA nanoframe of three states by different combinations of stimuli. Numbers in parentheses represent the number of analyzed structures (manually counted). The experiments were all repeated for three times.

stimuli					
UV irradiation (35 ^{o}C, 10 min)	K^+ (50 mM)	AS-1 (N)	RS (N)	AS-2 (N)	Total number
-	-	62% ± 2% (140)	31% ± 2% (70)	7% ± 1% (16)	226
-	+	55% ± 3% (115)	34% ± 6% (75)	10% ± 3% (21)	211
+	-	26% ± 11% (47)	63% ± 8% (119)	11% ± 5% (22)	188
+	+	18% ± 8% (40)	57% ± 7% (120)	26% ± 2% (65)	225

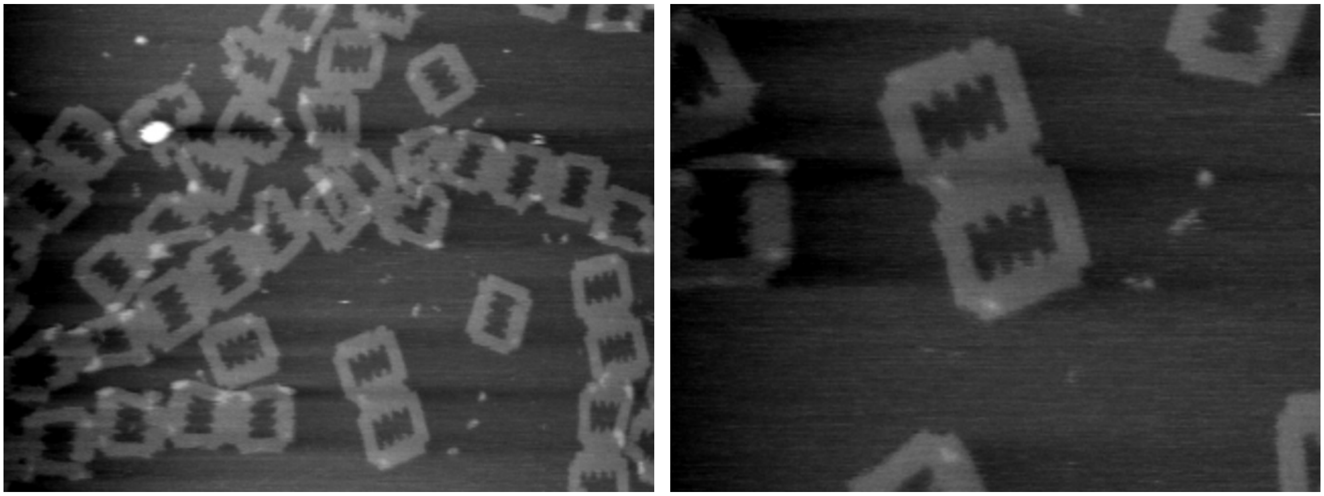


Fig. S1 AFM images of DNA nanoframe containing six protrusions inside of the vacant area. The hairpin marker is close to the dsEF side. Image size = 1000 nm × 800 nm (left) and 500 nm × 375 nm (right).

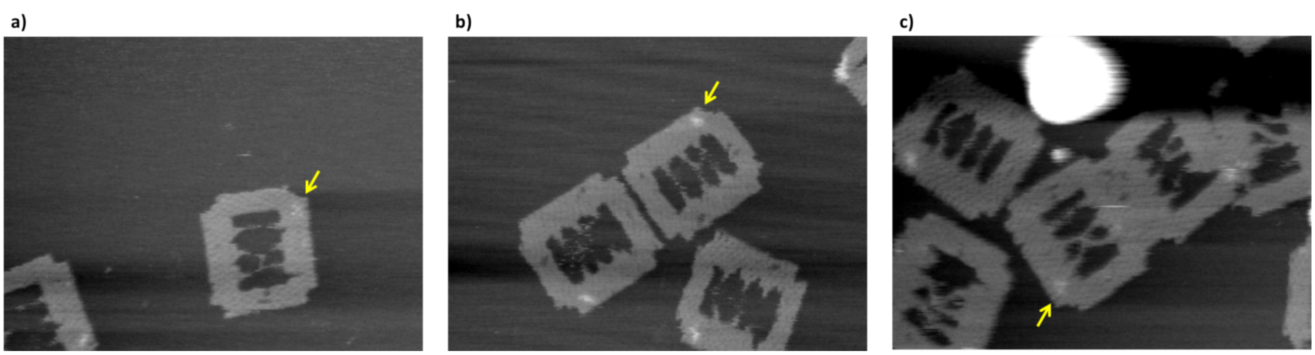


Fig. S2 AFM images of DNA nanoframe in three states: a) kissing state-1; b) relaxation state; c) kissing state-2. Image size = 400 nm × 300 nm. The hairpin marker to distinguish three double-stranded DNA was pointed by yellow arrows in each image.

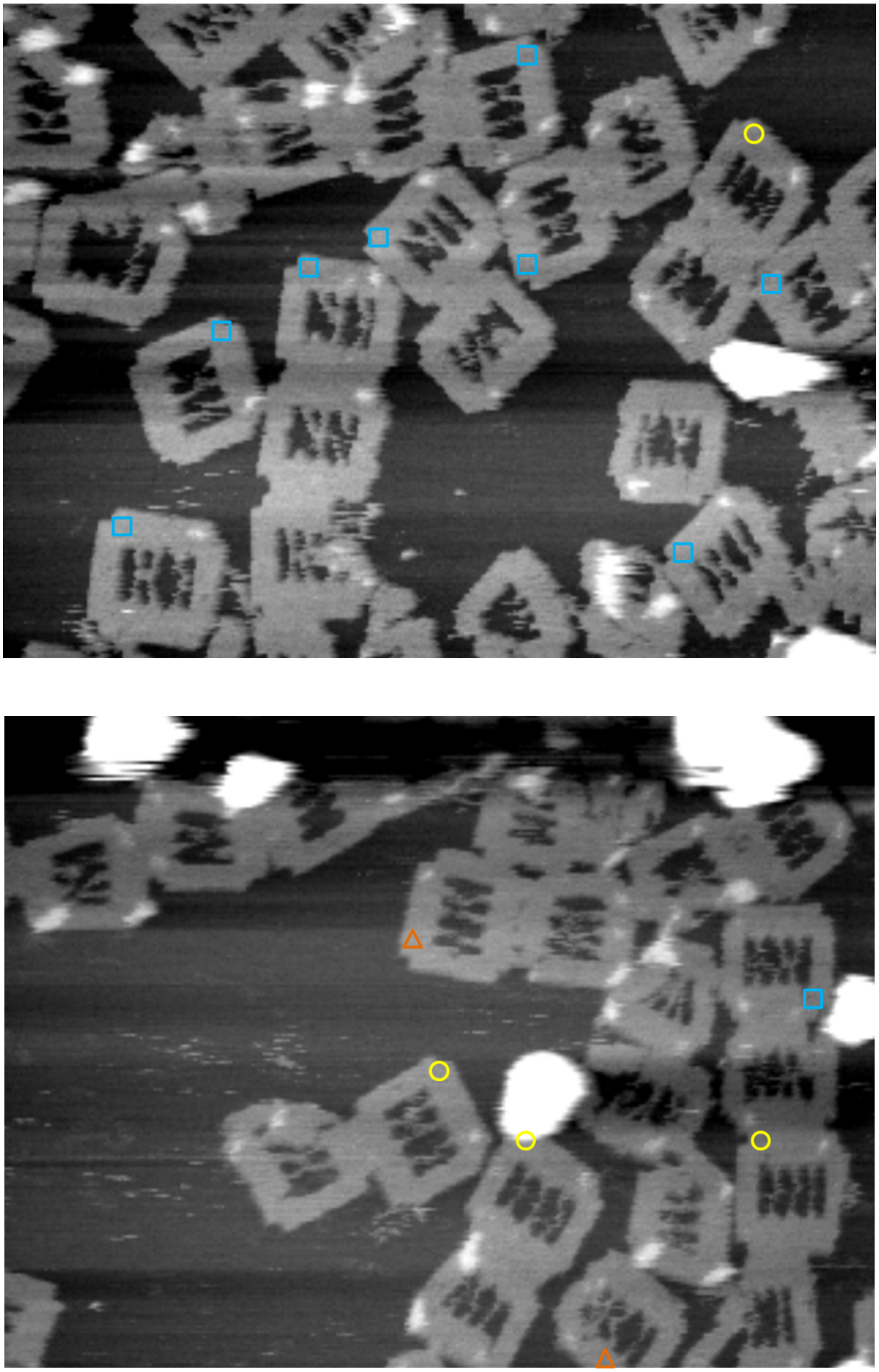
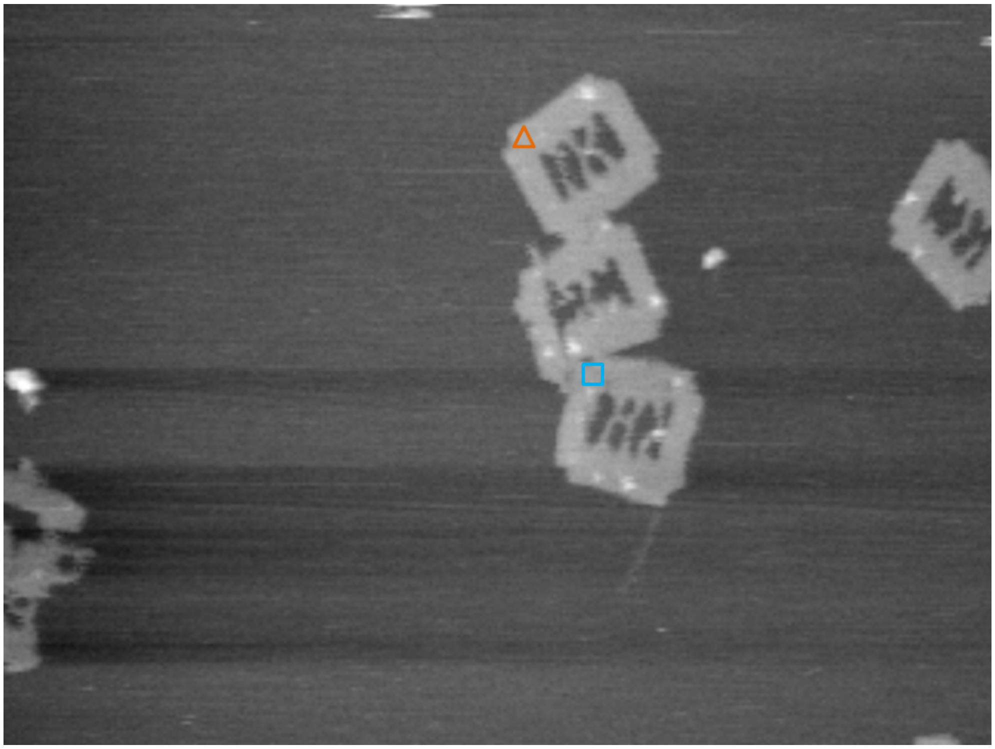


Fig. S3 AFM images of DNA nanoframe after the assembling of nanoframe scaffold with three dsDNAs carrying photoresponsive domains and G-tracts. Blue rectangle: AS-1; yellow circle: RS; orange triangle: AS-2. Image size: 800 nm × 600 nm.



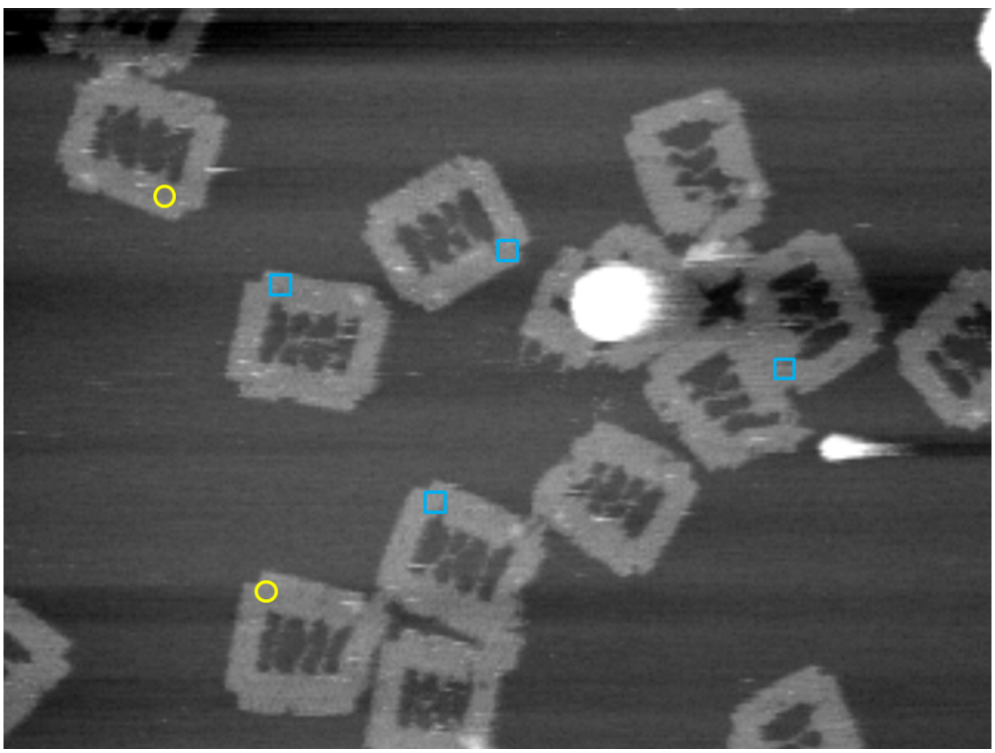


Fig. S4 AFM images of DNA nanoframe containing photoresponsive domain and G-tracts after the addition of K^+ (50 mM) without any photoirradiation. Blue rectangle: AS-1; yellow circle: RS; orange triangle: AS-2. Image size: 800 nm × 600 nm.

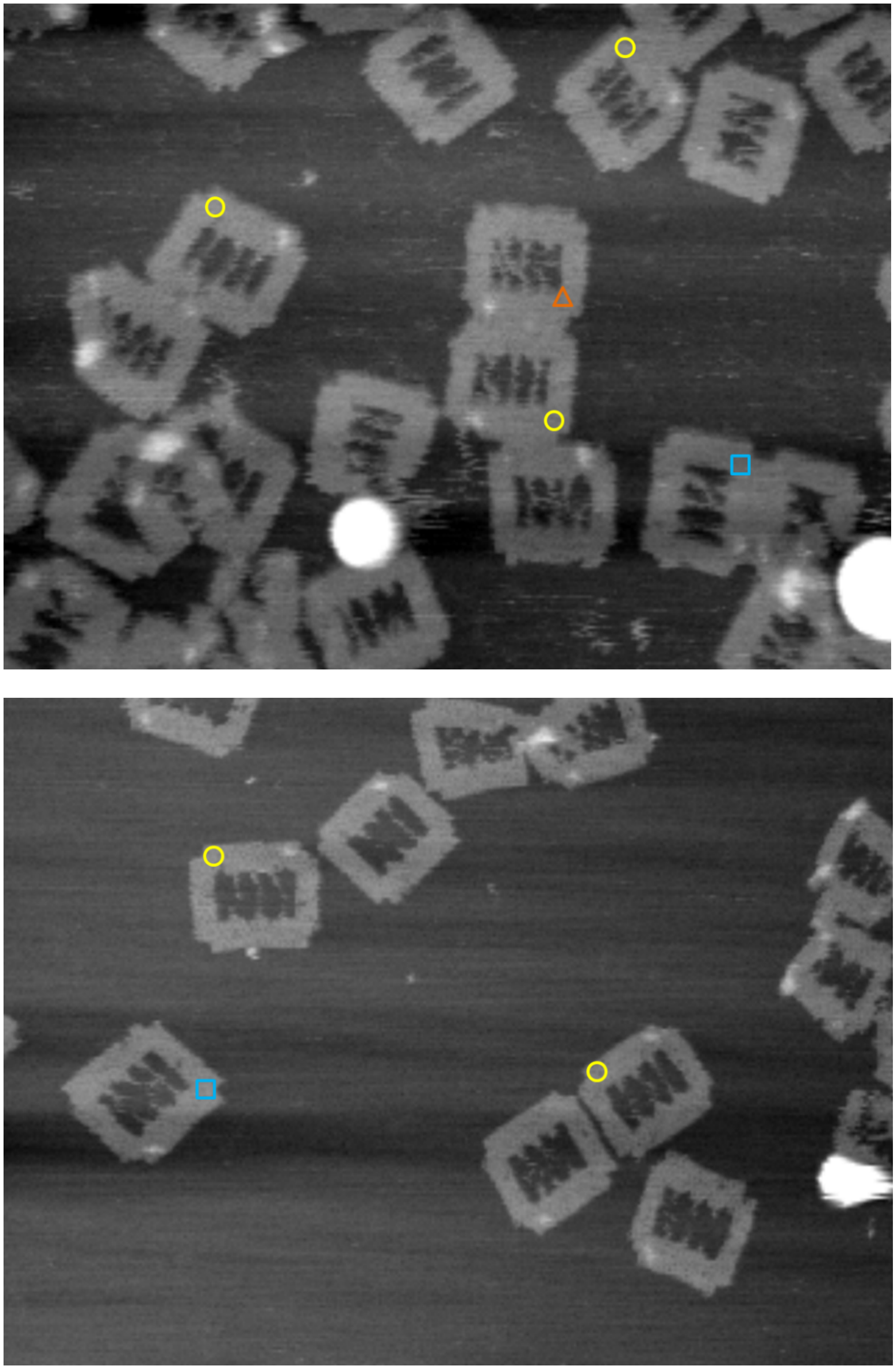


Fig. S5 AFM images of DNA nanoframe containing photoresponsive domain and G-tracts under the UV light irradiation (λ = 350 nm) for 10 minutes at 35 °C in the K^+-free buffer. Blue rectangle: AS-1; yellow circle: RS; orange triangle: AS-2. Image size: 800 nm × 600 nm.

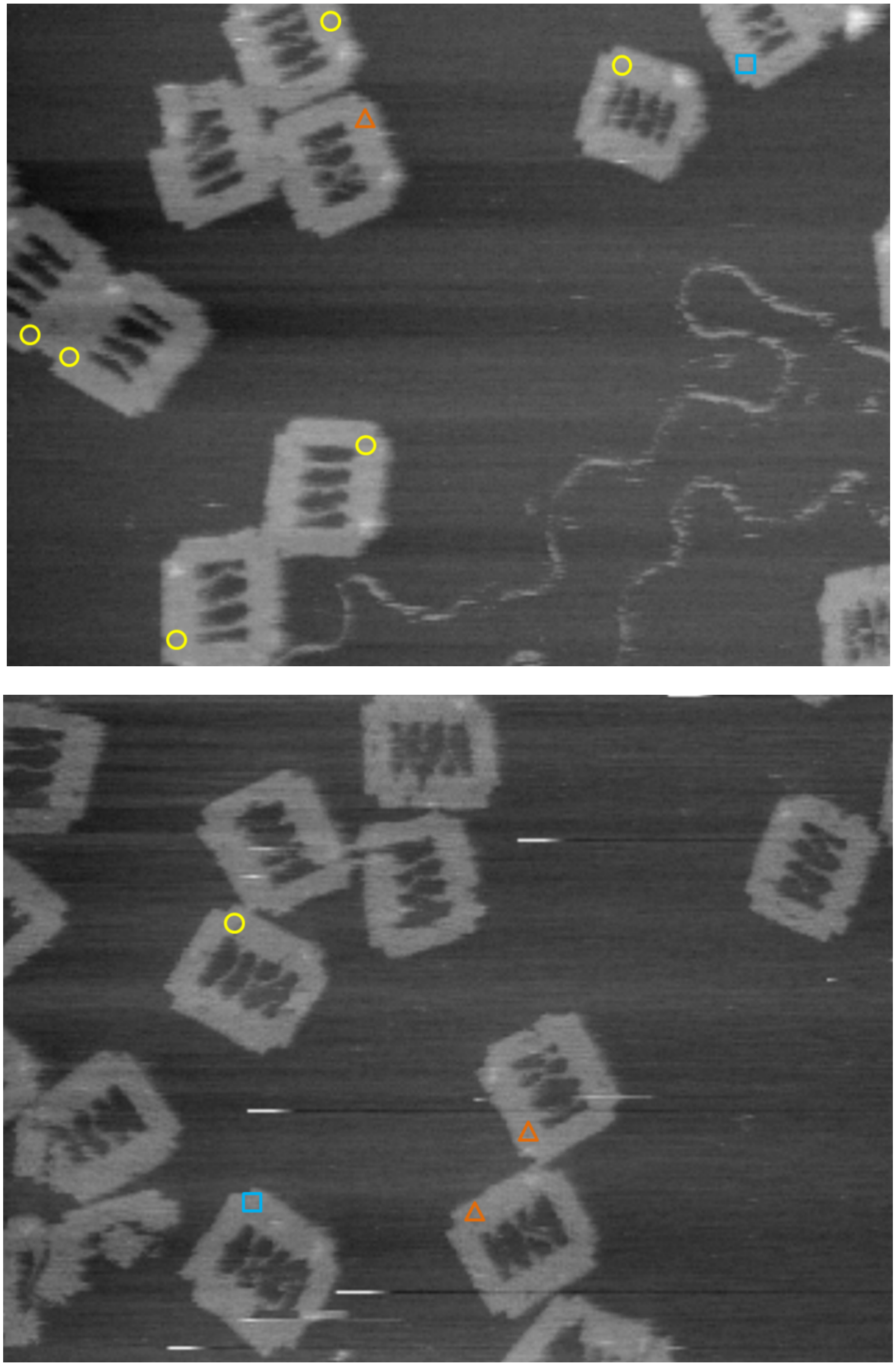


Fig. S6 AFM images of DNA nanoframe containing photoresponsive domain and G-tracts under the UV light irradiation (λ = 350 nm) for 10 minutes at 35 °C in the buffer containing potassium (50 mM). Blue rectangle: AS-1; yellow circle: RS; orange triangle: AS-2. Image size: 800 nm × 600 nm.

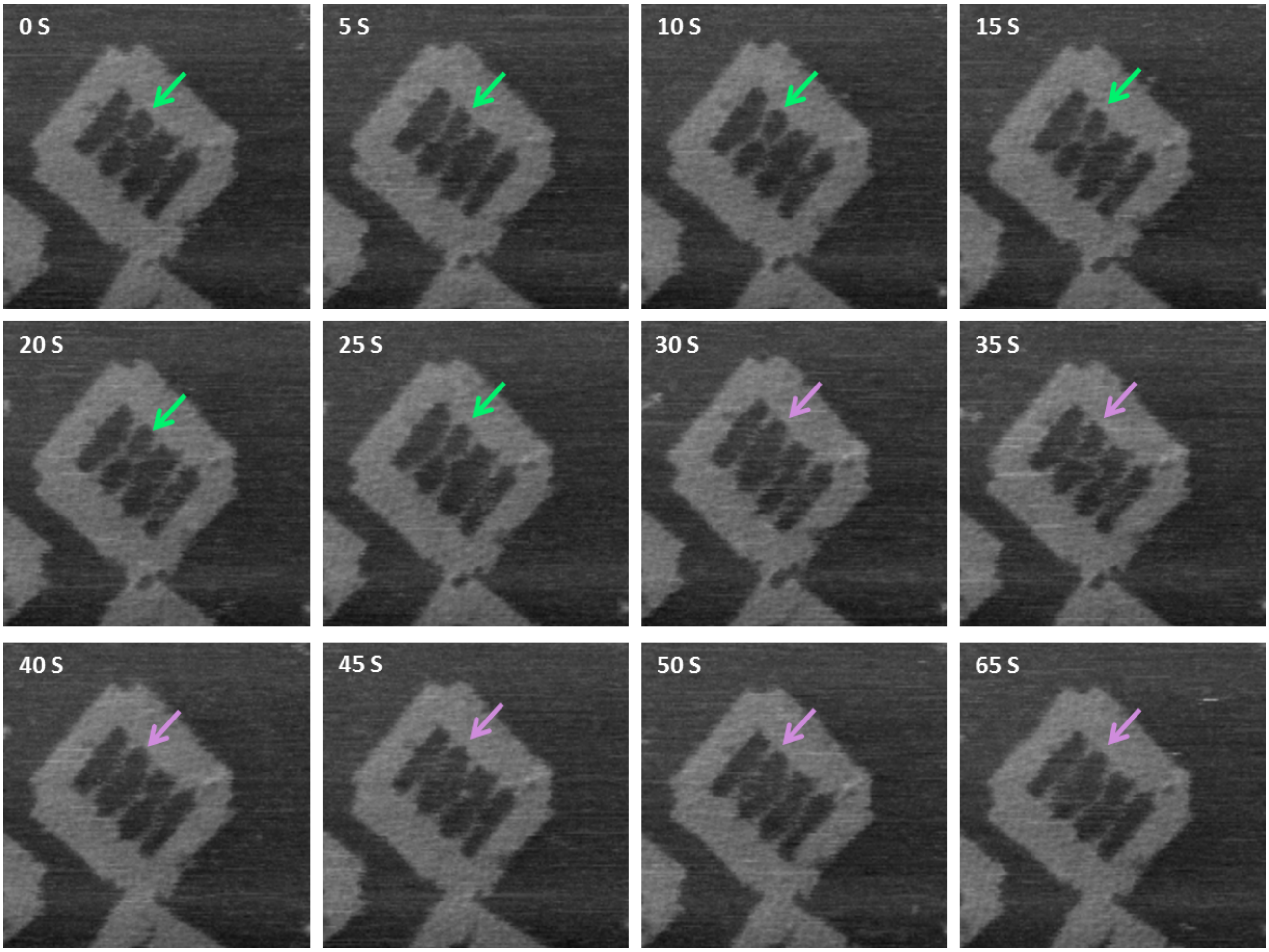


Fig. S7 The AFM images of s single nanoframe's configuration changing from AS-1 to RS under photoirradiation in UV wavelength in the K^+-free buffer. AFM scanning was 0.2 frames per second. Green arrows: AS-1; pink arrows: RS. Image size: 200 nm × 200 nm.

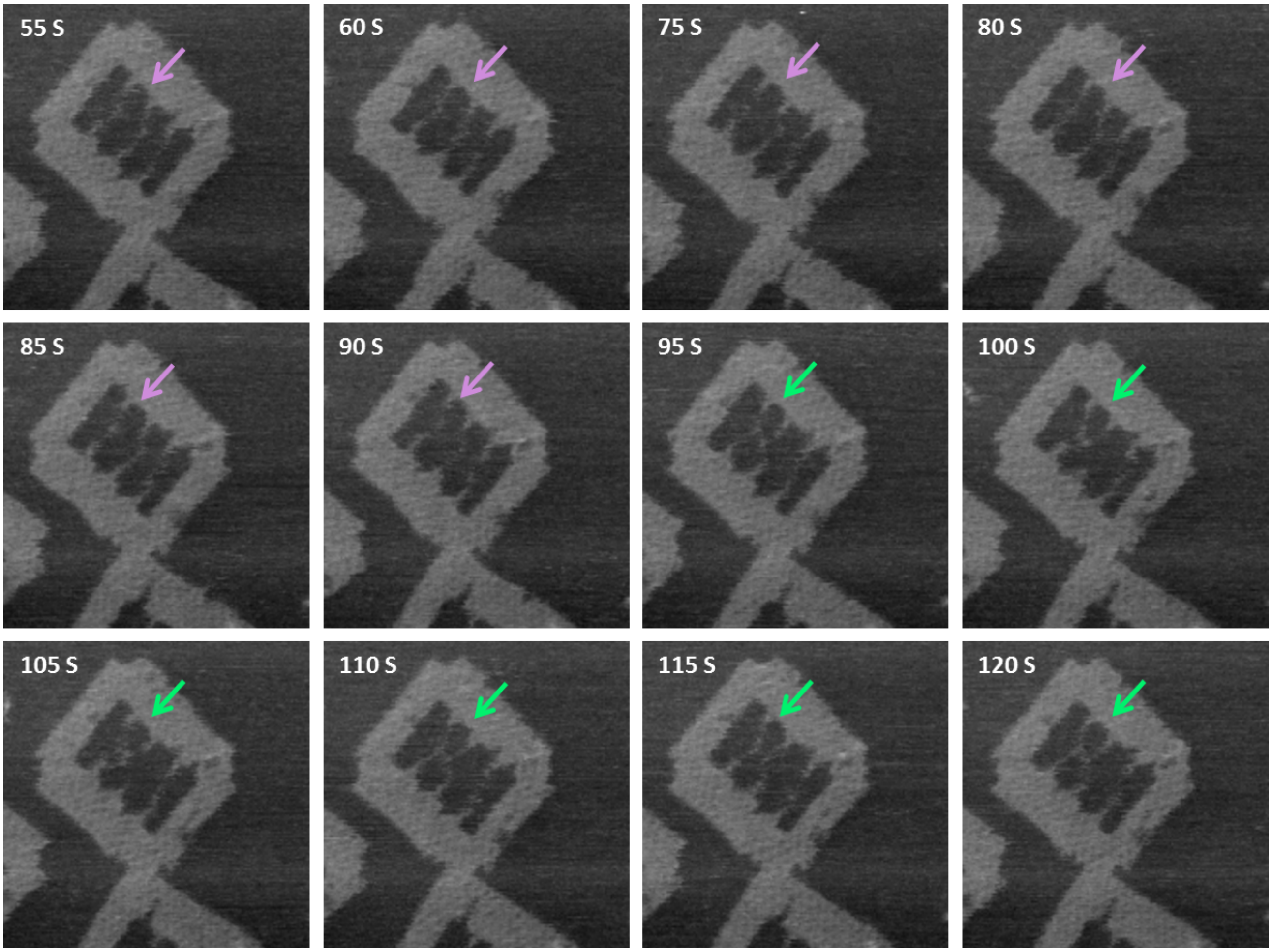


Fig. S8 The AFM images of s single nanoframe's reversible configuration changing from RS to AS-1 under photoirradiation in visible light wavelength in the K^+-free buffer. AFM scanning was 0.2 frames per second. Green arrows: AS-1; pink arrows: RS. Image size: 200 nm × 200 nm.

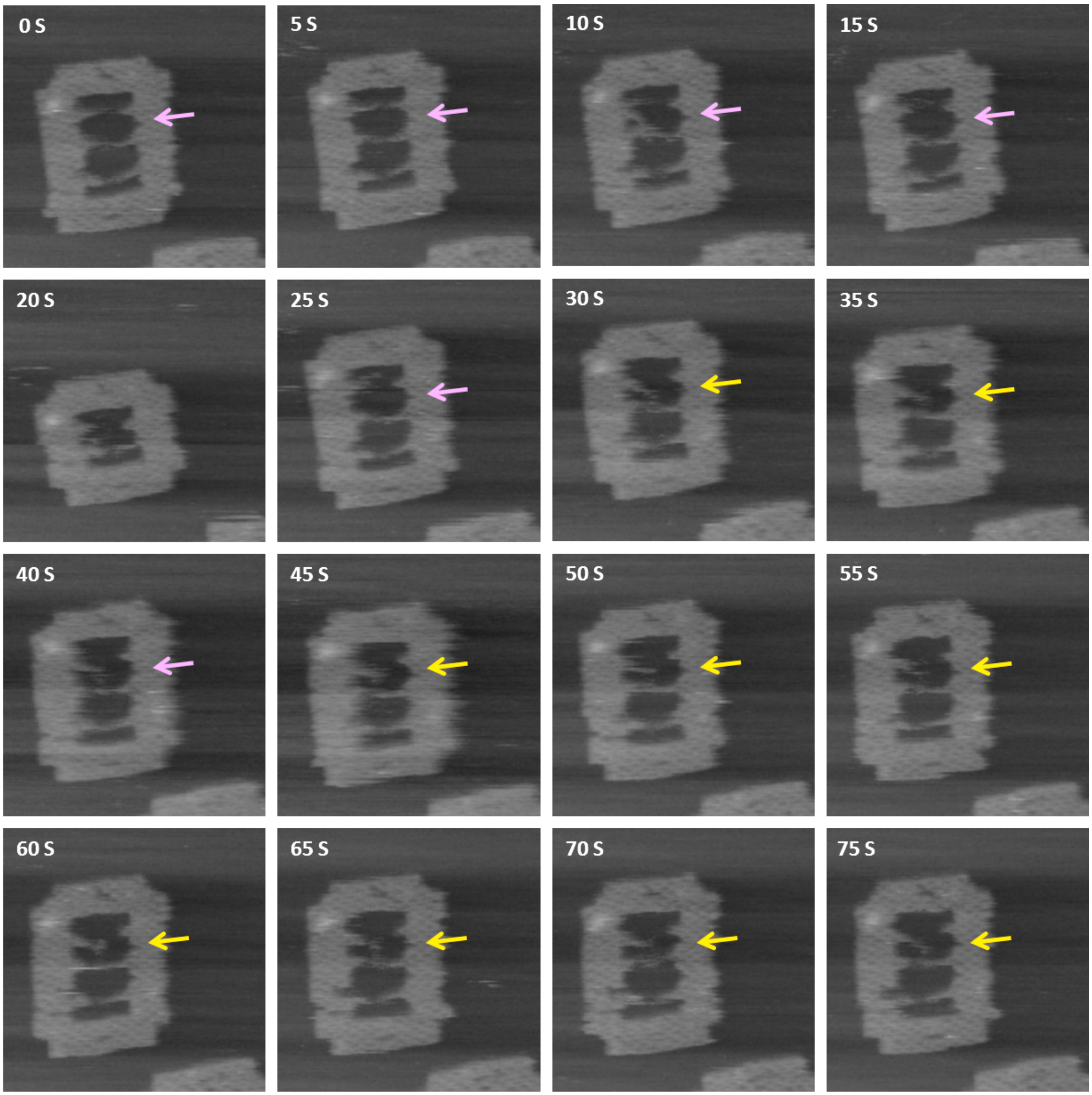


Fig. S9 The AFM images of s single nanoframe's configuration changing from RS to AS-2 under the buffer containing K^+ from the buffer without photoirradiation. AFM scanning was 0.2 frames per second. Orange arrows: AS-2; pink arrows: RS. Image size: 200 nm × 200 nm.

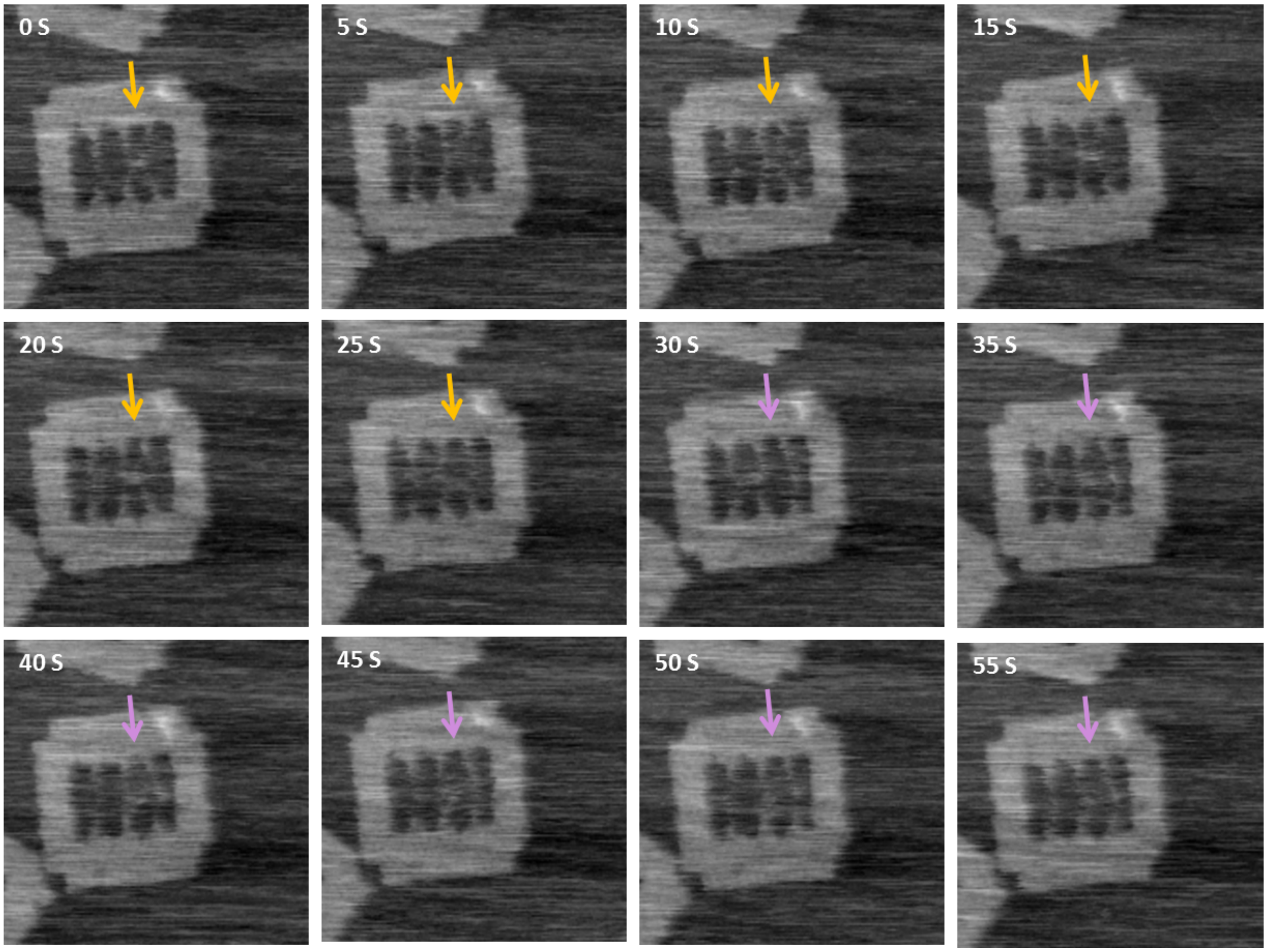


Fig. S10 The AFM images of s single nanoframe's reversible configuration changing from AS-2 to RS by removing the K^+ from the buffer without photoirradiation. AFM scanning was 0.2 frames per second. Orange arrows: AS-2; pink arrows: RS. Image size: 200 nm × 200 nm.

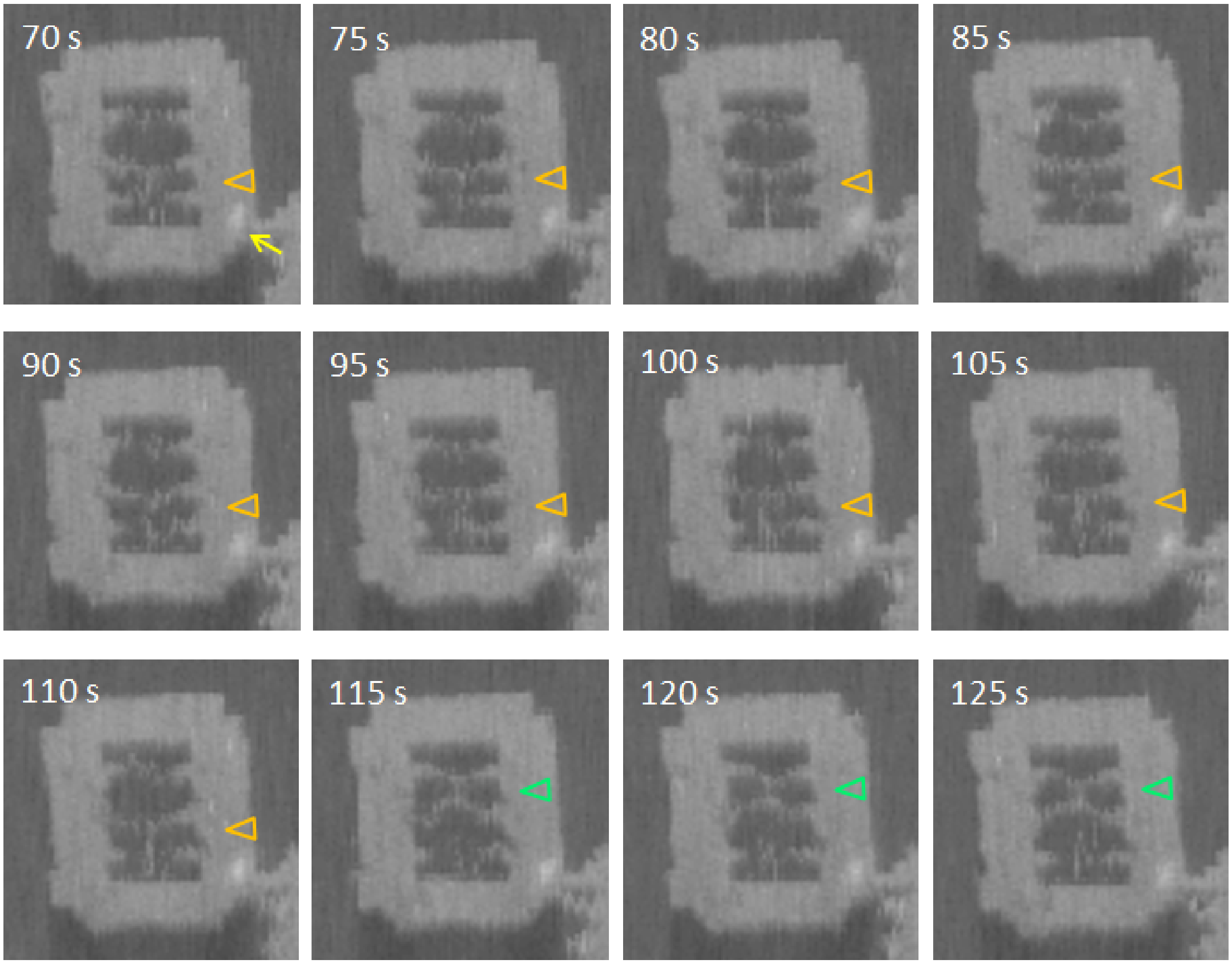


Fig. S11 The reversible AFM images of a single nanoframe's configuration changing from AS-2 to AS-1 under visible light irradiation in the observation buffer without K^+. AFM scanning rate was 0.2 frames per second. The time lapsed after starting photoirradiation was marked on each AFM image. The "kissing" between CD and EF was pointed by orange triangles while the "kissing" between AB and CD was pointed by green triangles. The unidentified state was pointed by dashed orange triangles. The marker was pointed by yellow arrows. Image size: 150 nm ×150 nm.

References

1. M. Endo, Y. Yang, Y. Suzuki, K. Hidaka, H. Sugiyama, *Angew. Chem. Int. Ed.* 2012, **51**, 10518.
2. M. Endo, Y. Katsuda, K. Hidaka, H. Sugiyama, *J. Am. Chem. Soc.* 2010, **132**, 1592.

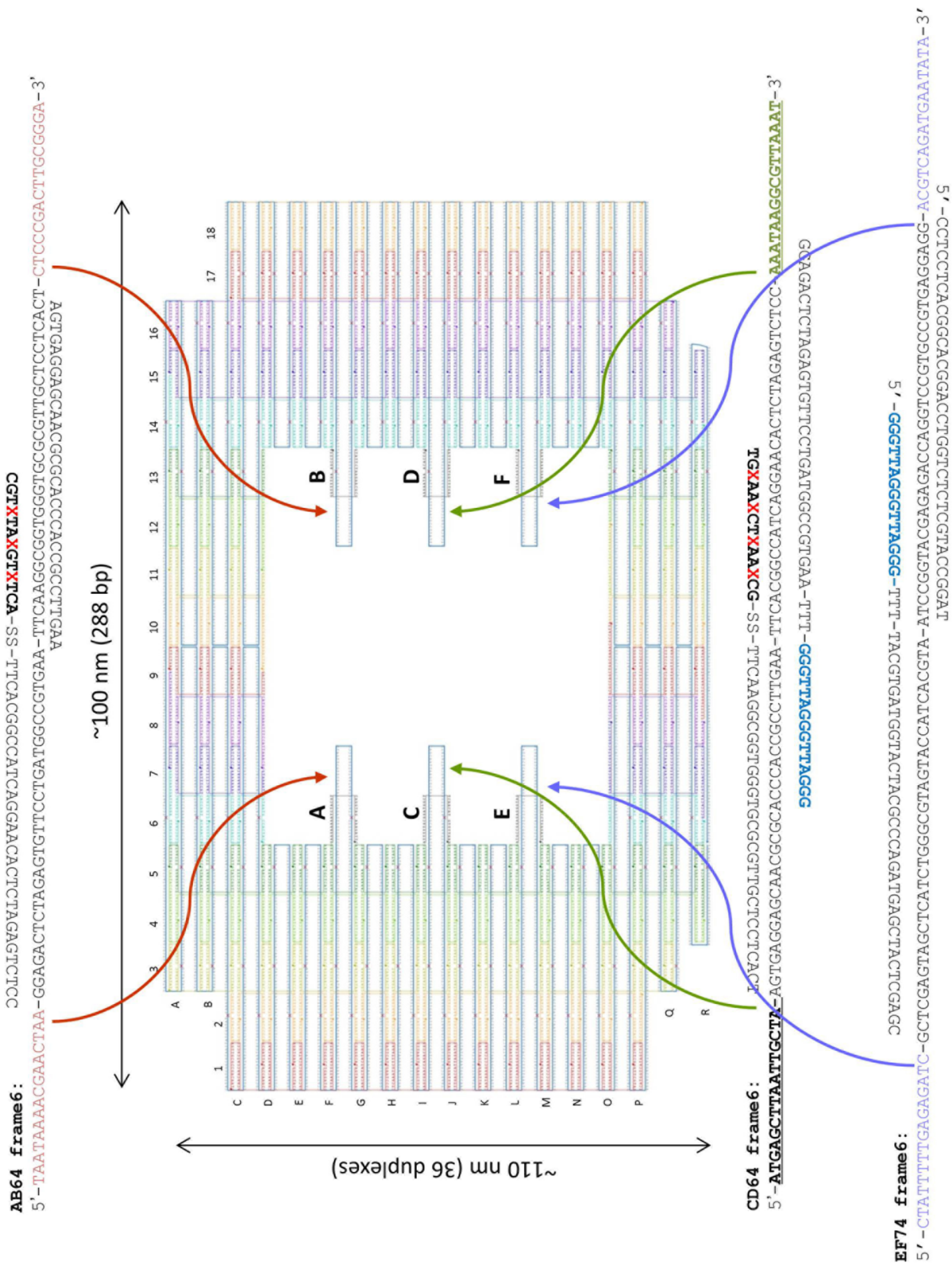


Fig. S12 Design of DNA nanoframe and locations of each strand described in **Table S1**.

Staple DNA strands for DNA nanoframe

position	sequence
1C	ACCAAGCGttttACAACAACCATCGCCCAGTTGCGCCGACAATG
1D	GGTGTACAttttCGAAACAAAGTACAACGCGATTAT
1E	TGAGATGGttttGACCAGGCGCATAGGCAGATGAAC
1F	AGTAAGAGttttTTTAATTTCAACTTTAATTGGGCT
1G	GAATCCCCttttCAACACTATCATAACCCGAGGCAT
1H	GAGCTTCAttttCTCAAATGCTTTAAACTATTCATT
1I	AGATTTAGttttAAGCGAACCAGACCGGTTTAATTC
1J	AAATTAAGttttTTTGACCATTAGATACGAACGAGT
1K	TAGGTAAAttttCAATAAAGCCTCAGAGAATTAGCA
1L	AATCAGAAttttGATTCAAAAGGGTGAGGTAATGTG
1M	TAGCCAGCttttAAGCCCCAAAAACAGGCGGTTGAT
1N	TCGGCCTCttttTTTCATCAACATTAAACCTTCCTG
1O	ATTCGTAAttttAGGAAGATCGCACTCCCGACAGTA
1P	TCATGGTCATAGCTGTGAGCTCGA
2C	CAGCTTGATACCGATACGCATAA
2D	CCGATATACATCTTTGACCCCCAGGAGATTT
2E	GTATCATCACTTTGAAAGAGGACTGGCTGAC
2F	CTTCATCACAGAACGAGTAGTAAATCATTGT
2G	GAATTACCCGCCAAAAGGAATTACTCGTTTA
2H	CCAGACGACGGAATCGTCATAAAAGTTCAGA
2I	AAACGAGACTTCAAATATCGCGTAAGCAAAC
2J	TCCAACAGGATTCCCAATTCTGCATTTCGCA
2K	AATGGTCAACAGGCAAGGCAAAGCATAAAGC
2L	TAAATCGGAAATGCAATGCCTGAAAAGGCCG
2M	GAGACAGTCAATCATATGTACCCAAGATTGT
2N-HP	ATAAGCAAATAATTCTCCTCTTTTGAGGAACAAGTTTTCTTGT GCGTCTGGTGTGAGCG
2O-HP	AGTAACAAAGTTTGATCCTCTTTTGAGGAACAAGTTTTCTTGT GGGGACGAAGCCAGCT
2P	TTCCGGCAGGATCCCCGGGTACCTTCCTGTGTGAAATTG
3A	GTAACGATttttAGTATAGCCCGGAATCGAGAGGGTTGATATA
3B	TTCTTAAACTAAAGTTTTGTCGTTAGTTAGC
3C	AAAACACTTTCGGTCGCTGAGGCAGGTGAAT
3D	ACTGACCAGCCTGATAAATTGTGAATACACT
3E	AGAAACACAGAGTAATCTTGACAGGAACCGA
3F	ATACATAATTATGCGATTTTAAGCCCTGACG
3G	CAATACTGCGATAAAAACCAAAATAATGCAG
3H	CCGAAAGAATGACCATAAATCAAATAGCGTC
3I	TAACAGTTGTCAGGATTAGAGAGGAGGAAGC
3J	TAAATCATATAACCTGTTTAGCTATTCCATA
3K	TATATTTTTTGTACCAAAAACATACATCCAA
3L	TAGCATGTCAAATCACCATCAATAACCCTCA

position	sequence
3M	CATCAAAAATATTTAAATTGTAACGTAAAAC
3N-HP	CATCTGCCCCCGTCGGTCCTCTTTTGAGGAACAAGTTTTCTTGT ATTCTCCAGGAACGC
3O-HP	ACTCTAGACCGCTTCTTCCTCTTTTGAGGAACAAGTTTTCTTGT GGTGCCGTAACCGTG
3P	CCAGTGAGTTATCCGCTCACAATGCAGGTCG
3Q	ACGGGCAACAGCTGATCTTTTCA
4A	CAGTACCAGGCGGATAAGTGCCGTAGGTGTAT
4B	CACCGTACCCACAGACAGCCCTCACTTTCCAG
4C	ACGTTAGTTATCAGCTTGCTTTCGTTGCAGGG
4D	AGTTAAAGACGAAAGAGGCAAAAGTCGAAATC
4E	CGCGACCTGACGGTCAATCATAAGAGAACCGG
4F	ATATTCATCAGTGAATAAGGCTTGAACTGGCT
4G	CATTATACGAATACCACATTCAACTAGCGAGA
4H	GGCTTTTGAAAATGTTTAGACTGGAAATCAGG
4I	TCTTTACCGCATCAAAAAGATTAATACCTTTA
4J	ATTGCTCCGGTGTCTGGAAGTTTCATATTTTC
4K	ATTTGGGGAATAGTAGTAGCATTATATGACCC
4L	TGTAATACGGATAAAAATTTTTAGATGATATT
4M	CAACCGTTATCGATGAACGGTAATACGTTAAT
4N	ATTTTGTTTCATTTTTTAACCAATGTGGGAAC
4O	AAACGGCGGTAGATGGGCGCATCGGAAACCAG
4P	GCAAAGCGCCAAGCTTGCATGCCTTCCACACA
4Q	ACATACGAGCGCCAGGGTGGTTTTTTGCCCTT
4R	CACCGCCTTATTAAAGAACGTGGACCAACGTC
5A	GTAGCATTTCAGGAGGTTTAGTAGTTTTGCT
5B	TATCGGTTAAATGAATTTTCTGTCAACGCCT
5C	AACCTAAAGCCGCTTTTGCGGGATTTAATTG
5D	GAGGCGCAGCTCCATGTTACTTAAAGGCACC
5E	TGCTCATTTACCCAAATCAACGTGCCGGAAC
5F	AGATTTAGCAGTCAGGACGTTGGAACAAAGC
5G	GTAATAGTCAAAAGAAGTTTTGCATCAGTTG
5H	AGCGGATTCTGACTATTATAGTCCAGAGGGG
5I	TAAAGTACTTTTGATAAGAGGTCAGAAGCAA
5J	ATTCTACTCGCGAGCTGAAAAGGTATGCAAC
5K	CAACGCAATTTTGCGGGAGAAGCTGGCATCA
5L	ACAAGAGACTAGCTGATAAATTACTTTATTT
5M	AAATCAGCAAAATTCGCATTAAATGGAGCAA
5N	ACGTTGGTGATTGACCGTAATGGTTTTTGTT
5O	GGCCAGTGCCATTCGCCATTCAGGATAGGTC
5P	CGTATTGGGCCGGAAGCATAAAGAAAACGAC
5Q	GAGTCCACGGCCCTGAGAGAGTTGCGGTTTG

position	sequence
5R	AAAGGGCGAAAAACCGTCTATCATGGAACAA
6A	AGAGAAGGATTAGGATTAGCGGGCCGCCACC
6B	CTCAGAACCACCAGTACAAACTAATGGGATT
6C	TTGCTAAAGCTCCAAAAGGAGCCTCGTCACC
6CD	CTCAGCAGCGTAATGCCACTACG
6EF	GAAGAAAAATCTACGTCAGGTAGAAAGATTC
6IJ	ATTTTTGCGGATGGCTTCAACATGTTTTAAA
6LM	ATGCCGGAGAGGGTAGTCATTGCCTGAGAGTC
6P	GCTGCGCAACTGTTGGCAGTCACGACGTTGTTGTAAAGC
6Q	CTGGGGTGAACGCGCGGGGAGAGGCAGCAAG
6R	CGGTCCACAGTGTTGTTCCAGTTGGGCGATG
7A	AGTTTCGTCGCCACCCTCAGAACCACTCCTCA
7B	AAAAAAAGCAACTTTCAACAGTTTTAACACTG
7C	GTAAAATACGAAAGACAGCATCGGAATCTCCA
7LM	ACAAAGGCTATCAGGTCTAGCTGATAAATTAA
7OP	GGTTTTCCGAAGGGCGATCGGTGCGGGCCTCT
7P	AATCGGCCCCTAATGAGTGAGCTAAACGCCAG
7Q	TAGGGTTGGCTGGTTTGCCCCAGCCATTAATG
7R	GCCCACTACGTGAACCATCACCCAGCCCGAGA
8A	ACATGAAAGTATTAAGAGGCTGAGGCCACCCT
8B	CAGAGCCAAGGAACCCATGTACCGCAGCGGAG
8C	TGAGAATAATTTTTTCACGTTGAAAACGAGGG
8CD	TAGCAACGCATGAGGAAGTTTCCATTAAACGG
8P	TCGCTATTGGCGATTAAGTTGGGTACTCACAT
8Q	TAATTGCGCCTGTCGTGCCAGCTGAGGCGAAA
8R	ATCCTGTTATAAATCAAAAGAATAAATCAAGT
9A	AGCCCAATCCACCCTCATTTTCAGATTCTGAA
9B	GAATAATAGAAAGGAACAACTAAAGGATAGCA
9C	GACTTTTTGCTACAGAGGCTTTGAGGAATTGC
9OP	TGCTGCAAACGCCAGCTGGCGAAACGCCATTA
9P	TCGGGAAATTGCGCTCACTGCCCGGGGGGATG
9Q	AATCCCTTTGATGGTGGTTCCGAACTTTCCAG
9R	TTTTTGGGGTCGAGGTGCCGTAAAATCGGCAA
5R	AAAGGGCGAAAAACCGTCTATCATGGAACAA
6A	AGAGAAGGATTAGGATTAGCGGGCCGCCACC
6B	CTCAGAACCACCAGTACAAACTAATGGGATT
6C	TTGCTAAAGCTCCAAAAGGAGCCTCGTCACC
6CD	CTCAGCAGCGTAATGCCACTACG
6EF	GAAGAAAAATCTACGTCAGGTAGAAAGATTC
10A	CCCCTGCCTATTTCGGAACCTATTTGAGGCAG
10B	GTCAGACGAGCATTGACAGGAGGTCTTTAGCG
10C	TCAGACTGACAGAATCAAGTTTGCGACACCAC

position	sequence
10CD	GGAATAAGATAAAAGAAACGCAAAGGACTAAA
10P	AAAATACCGATAGCCCTAAAACATAGAACTCA
10Q	AACTATCGCACTTGCCTGAGTAGAGCTTTGAC
10R	GAGCACGTGGCGCGTACTATGGTTGCACTAAA
11A	CCGCCGCCATTGGCCTTGATATTCGTTAATGC
11B	CAGTAGCGTAGCGCGTTTTCATCGCACCAGAG
11C	GGCAACATTTTATTTTGTCACAATACCGTAAT
11OP	CGCGAACTGAACGAACCACCAGCAGAAGATAA
11P	AATAACATGCCTTGCTGGTAATATCTTTAATG
11Q	CGCTACAGATAACGTGCTTTCCTCTGATTAGT
11R	TCGGAACCCTAAAGGGAGCCCCCGTAATGCGC
12A	TGAGTAACAGTGCCCGTATAAACAACAAACAA
12B	ATAAATCCCCGCCACCAGAACCACGCATTTTC
12C	GGTCATAGAACCATCGATAGCAGCCAATAGAA
12CD	AATTCATACGTAGAAAATACATACATAAAGGT
12LM	TACATCGGGAGAAACATAGATTTTCAGGTTTA
12P	AACAGAGGTTGAATGGCTATTAGTCCAGAACA
12Q	ATATTACCTGTAGCAATACTTCTTGTTAGAAT
12R	CAGAGCGGCCACACCCGCCGCGCTATTTAGAG
13A	CCTCAGAGTCATTAAAGCCAGAACAGTGCCT
13B	ACCAATGACCCCCTTATTAGCGTGCCACCAC
13C	GCAGTATGTTAGCAAATGGTTTACCAGCGCCGAAACGTC
13EF	GTATTCTAAGAACGCGGGTTTTGAAGCCTTA
13IJ	AATTTAATGGTTTGAAAAGAATAAACACCGG
13LM	AAATAAAGAAATTGCGCAGTAACAGTACCTTT
13OP	CAATATTTTGAGGCGGTCAGTAT
13P	TTAACCGTGCCAGCCATTGCAACGGCACAGA
13Q	CGTAACCAGAGCTAAACAGGAGGCACGCAAA
13R	CTTGACGGGGAAAGCCGGCGAACACGCTGCG
14A	CTGGTAATAAGTTTTAACGGGGTTGGAAAGC
14B	GCAGTCTCACCGCCACCCTCAGATTGCCATC
14C	TTTTCATACCATTAGCAAGGCCGAAAGACAA
14D	AAGGGCGAAAGACTCCTTATTACAAGAGCAA
14E	GAAACAATGTTAAGCCCAATAATCAAAAATG
14F	AAAATAGCTTTTTTGTTTAACGTAATCAAGA
14G	TTAGTTGCTAGAAGGCTTATCCGAACCAATC
14H	AATAATCGTTACGAGCATGTAGAAAGAGAAT
14I	ATAAAGTATTTCGAGCCAGTAATAATCATAA
14J	TTACTAGATCATCTTCTGACCTATTATCAAA
14K	ATCATAGGGAGTCAATAGTGAATTGAATTAC
14L	CTTTTTTATTTAACAATTTCATTTACATCGG
14M	GAGAAACATTGCACGTAAAACAGGGAACAAA

position	sequence
14N	GAAACCACACATTATCATTTTGCTTTAGGAG
14O	CACTAACAGTTATCTAAAATATCTAACACCG
14P	CCTGCAACAGCGTAAGAATACGTAGGAAAAA
14Q	CGCTCATGAAAGAGTCTGTCCATCCGATTAA
14R	AGGGATTTGCAAGTGTAGCGGTCGTGGCGAG
15A	CCCTCAGATGAATTTACCGTTCCAGGAGTGTA
15B	CACCATTAATCAAAATCACCGGAAAGCCGCCA
15C	GCATGATTCATTCAACCGATTGAGACCAGTAG
15D	AGAATTGAGAAATAGCAATAGCTAAAGAACTG
15E	AGAAACGAAGCCTTTACAGAGAGAAACCCACA
15F	ATCAGATATATTTTGCACCCAGCTTCCAAATA
15G	ATCCTAATGCTGTCTTTCCTTATCGCAAGCAA
15H	AGAGGCATCCGACAAAAGGTAAAGAATATCCC
15I	AGTTAATTAAAAGCCTGTTTAGTAATTTAGGC
15J	GCTGAGAATCTGAGAGACTACCTTTATATTTT
15K	TAATTACAATGGAAACAGTACATAATTAAGAC
15L	AAAATTATATAACGGATTCGCCTGAACAAAAT
15M	TTTGAGTACAGAAGGAGCGGAATTACCATATC
15N	TGAGGAAGACTAATAGATTAGAGCTTTAAAAG
15O	GACCTGAAAGTGCCACGCTGAGAGAAAGGAAT
15P	ACCGAGTAGAAATACCTACATTTTACCCTTCT
15Q	GGGCGCTGTAGACAGGAACGGTACGTGAGGCC
15R	AAAGGAAGGGAAGAAAGCGAAAGGGGGCGCTA
16A	GCTTTTGATGATACAGTAAGCGT
16B	CATACATGttttAACCGCCTCCCTCAGCCAGAGCC
16C	ACCACCGGAGAGCCAGCAAAATCGGAGGGAA
16D	GGTAAATATAACGGAATACCCAATCTTACCG
16E	AAGCCCTTTAATATCAGAGAGATATAACATA
16F	AAAACAGGTATTATTTATCCCAAACAATTTT

position	sequence
16G	ATCCTGAATTACCGCGCCCAATAATTCCAAG
16H	AACGGGTACTGAACAAGAAAAATTAATTCTG
16I	TCCAGACGCAACGCCAACATGTATCATATGC
16J	GTTATACAGAAAACTTTTTCAAATTTAACCT
16K	CCGGCTTAATAGCGATAGCTTAGAATCAATA
16L	TATGTGAGAACAAACATCAAGAAATTGCTTT
16M	GAATACCAGAAGGGTTAGAACCTATCATCAT
16N	ATTCCTGACCGAACGTTATTAATCGTCAATA
16O	GATAATACGCAAATCAACAGTTGCCAGCAGC
16P	AAATGAAAGCCAACAGAGATAGAGACGCTCA
16Q	ATCGTCTGGTGTTTTTATAATCAGCCAGAATCCTGAGAA
17C	CGCAATAATTGACGGAAATTATTGAGCCATTTGGGAATT
17D	TTGAGCGCTTTAAGAAAAGTAAGCGAGGAAA
17E	AACAGCCAGAAGCGCATTAGACGGAGGGTAA
17F	AGGAATCATCTTACCAACGCTAAACAAAATA
17G	GATAAGTCTTAAACCAAGTACCGTTCATCGT
17H	ATATTTAAACGACAATAAACAACCAACAATA
17I	GAACGCGAAATTCTTACCAGTATGAATCGCC
17J	TTGAAAACGGTTGGGTTATATAAAAGACAAA
17K	GATGATGATGAATAACCTTGCTTTAGAATCC
17L	GAATAATGAGTTACAAAATCGCGCAAAAGAA
17M	TCCTTTGCTTATCAGATGATGGCATACTTCT
17N	GTCAGTTGATTTGAGGATTTAGAGTATTAAA
17O	ACATTCTGAATCTAAAGCATCACAATATCTG
17P	AAATGGATTATTTACTAAAAGGG
18C	TCACCGTCACCGACTTCATTAAAG
18D	GTGAATTAttttGTTACCAGAAGGAAACCAGATAGC
18E	CGAACAAAttttACCCTGAACAAAGTCAGGAGAATT
18F	AACTGAACttttGCCTAATTTGCCAGTTCGAGCGTC