**Supplementary File 1.** DNA oligonucleotide sequences for the DNA origami rod. The asterisk indicates the C6dT modified oligonucleotide. Small letters "tttt" indicate the four-thymine (4T) linker added to prevent the aggregation of DNA rods.

|  |  |
| --- | --- |
| Seq Name | Sequence |
| Rod2\_001\_4T2  Rod2\_002  Rod2\_003  Rod2\_004  Rod2\_005  Rod2\_006\_4T2  Rod2\_007  Rod2\_008  Rod2\_009\_4T  Rod2\_010\_4T2  Rod2\_011  Rod2\_012\_L  -NdT3\_T30  Rod2\_013\_4T2  Rod2\_014  Rod2\_015  Rod2\_016  Rod2\_017\_4T2  Rod2\_018  Rod2\_019\_4T2  Rod2\_020  Rod2\_021  Rod2\_022  Rod2\_023\_4T2  Rod2\_024  Rod2\_025  Rod2\_026  Rod2\_027  Rod2\_028  Rod2\_029  Rod2\_030  Rod2\_031  Rod2\_032  Rod2\_033  Rod2\_034\_4T2  Rod2\_035\_4T2  Rod2\_036  Rod2\_037  Rod2\_038  Rod2\_039  Rod2\_040  Rod2\_041\_4T  Rod2\_042  Rod2\_043  Rod2\_044\_4T2  Rod2\_045  Rod2\_046  Rod2\_047\_4T2  Rod2\_048  Rod2\_049\_4T2  Rod2\_050\_4T2  Rod2\_051\_4T  Rod2\_052  Rod2\_053  Rod2\_054  Rod2\_055  Rod2\_056  Rod2\_057  Rod2\_058  Rod2\_059  Rod2\_060  Rod2\_061  Rod2\_062  Rod2\_063  Rod2\_064  Rod2\_065  Rod2\_066  Rod2\_067  Rod2\_068  Rod2\_069  Rod2\_070  Rod2\_071  Rod2\_072  Rod2\_073  Rod2\_074  Rod2\_075  Rod2\_076  Rod2\_077  Rod2\_078  Rod2\_079  Rod2\_080  Rod2\_081  Rod2\_082  Rod2\_083  Rod2\_084  Rod2\_085  Rod2\_086  Rod2\_087  Rod2\_088  Rod2\_089  Rod2\_090  Rod2\_091  Rod2\_092  Rod2\_093  Rod2\_094  Rod2\_095  Rod2\_096  Rod2\_097  Rod2\_098  Rod2\_099  Rod2\_100  Rod2\_101  Rod2\_102  Rod2\_103  Rod2\_104  Rod2\_105  Rod2\_106  Rod2\_107  Rod2\_108  Rod2\_109  Rod2\_110  Rod2\_111  Rod2\_112  Rod2\_113  Rod2\_114  Rod2\_115  Rod2\_116  Rod2\_117\_R-NdT3\_T30  Rod2\_118  Rod2\_119  Rod2\_120  Rod2\_121  Rod2\_122  Rod2\_123  Rod2\_124  Rod2\_125  Rod2\_126  Rod2\_127  Rod2\_128  Rod2\_129  Rod2\_130  Rod2\_131  Rod2\_132  Rod2\_133  Rod2\_134  Rod2\_135  Rod2\_136  Rod2\_137  Rod2\_138  Rod2\_139  Rod2\_140  Rod2\_141  Rod2\_142  Rod2\_143  Rod2\_144  Rod2\_145  Rod2\_146  Rod2\_147  Rod2\_148  Rod2\_149  Rod2\_150  Rod2\_151  Rod2\_152  Rod2\_153  Rod2\_154  Rod2\_155  Rod2\_156  Rod2\_157  Rod2\_158  Rod2\_159  Rod2\_160  Rod2\_161  Rod2\_162  Rod2\_163\_4T  Rod2\_164\_4T  Rod2\_165  Rod2\_166  Rod2\_167\_4T2  Rod2\_168  Rod2\_169\_4T  Rod2\_170  Rod2\_171  Rod2\_172\_4T2  Rod2\_173  Rod2\_174  Rod2\_175  Rod2\_176\_4T  Rod2\_177  Rod2\_178\_4T2  Rod2\_179  Rod2\_180  Rod2\_181  Rod2\_182  Rod2\_183  Rod2\_184  Rod2\_185  Rod2\_186\_4T2  Rod2\_187  Rod2\_188  Rod2\_189  Rod2\_190  Rod2\_191  Rod2\_192\_4T2  Rod2\_193  Rod2\_194  Rod2\_195  Rod2\_196\_4T2  Rod2\_197  Rod2\_198  Rod2\_199  Rod2\_200\_4T  Rod2\_201\_4T2  Rod2\_202  Rod2\_203\_4T2  Rod2\_204  Rod2\_205  Rod2\_206\_4T  Rod2\_207  Rod2\_208\_4T2  Rod2\_209\_4T2 | ttttGGGCGATGGCCGTCTATCAtttt  CCAACGTCGTAATCGCGTGCCTGTTCTTCTCGTCGGAATAAG  AAAGAACGTGGACTCAAATCAAGTTTTTACTATCGATTTTGAGATTAGA  CACTATTTTCCTGTACCGGGGGTTTCTGCCAGAGCACATCCT  AAGAGTCGAGGTGCCGTAAAGTGCCTGAAAATGGA  ttttTTGAGGATCCCCGGGTGTGAGCCTCCTCACAGtttt  ACCGAGCTCGAATTCAAAGGGCTTGCAGCAACAAC  GGCGCTTTCCTTAGTGACCTCCGGCCAGCACATGGTCATAGCTGT  ttttCGACAGTATCGGCCTCAGGAAGAAAACGATTTTTCGTCGCGTCC  ttttGCAAACGCGGAAACACCAGAAtttt  CTGGCAGTGAAGGGTAAAGTTTCGCACTGCCCGAA  \*T\*T\*ttttttttttttttttttttttttttttttAGCCGCACAGGCGGCCTGGCACCGCTTCTGGGTCACGTTGGTGTAGATG  ttttATATATTCGGTCCTGACGAGTCCGTTGCTGATTGCCGTTCCGtttt  CATAACGCGGTCATGTGAAATTGTTATCTTGGAAC  CAACAGGCAACGCAGTCAAATCACCATCGGGATAGTGCCGGAAAAA  CCAGCCAGCATCGTAACCGTGTTCAAAA  ttttAGTAATGTGTAGGTAAAGACATCTGCCAGTTTGAGGGGACGAtttt  GGAGACAAGGATAAAAATTTTTAGAACCGGGTGAGAAAGGCC  ttttGTTTTAATTATGCAATGCCTGtttt  CTCATATATTTTAACGAGCTTAGACTTCGAGATGG  CAAAGCGGCAAGGCCTGAACAATAAAAACAGGGAACTAATGCAGAACGC  AACCAGACCGGAAGAAGATTATAATCATGCTGCTC  ttttCGAGTAGTAAATTGGGCTTAAATATCGCtttt  GTTTGCCGACTCCTCAAGAGATCAACTTAGAGGAA  TTTAATTAGGATTAAGCGACAGTCCAGACGACGACTCGCTAT  TGTGAATAGGCTGATTTAGCGGACAAAAAATAGATAAGTCCT  TACCTTACGGATTGCATCAAACAAACTCCCAGTAGTTGAGCG  GCTTGCCGCTGAGGCGAAAAACCCACTACGTGAACATCCAGAAACGCTC  ATTAAATGCCGTCAATAGATAATGGAAAACAATGAGGAGTTAATTCAGT  ACTAACAACTAATACGCTCAATTGATACGGGATCGATCAACGTAACAAA  AGAAGCCTTTATTTTCAGGATAGCAAAGTGCGATTTACCCAA  AAGGCCGCTTTTGCCGATAGTCCGGAATAAACAGT  TCACCCTCAGCAGCATTTCTTACTCAGGTTGAATT  ttttCCATTGCAACACGCATAACCGtttt  ttttACCAGGCGGATAAGTGCGGGGTTTTGCTCAGTtttt  CCGTCGACATCGCCCAGGAAAACAATATTACCGCCAG  GAGGGTTATGTGAGTAATTAATTTTCCCTAATTCTGAATCAAACCATTA  ATACATTATTCGACAACTCGTTCAATATGATATAA  GTATAGCTGCGCCGTACCTACGCCTTGCTGGTAATCATCACC  TCACCGTAAACAGCTCGTCTGGTAGAAGAACTCAATGGGGTC  ttttGGAGAATTAACTGAACACCCGGAAACAATCAGTGGATTAG  CCTTTGCCCGAACGTTAATGGAGGTGTATATTAAG  AAATAGCCTAATATCAGAGAGAGCCAGCGTAGCGCATGAAAG  ttttTCGATAGCAGCACCGTGTCACCAATGAAACCAtttt  GCCTGTTGAATAACAAGTCAGAGGGTAACACCATT  CCTTGAAAACATAGAAGTACCTCAGACTAAAATCA  ttttCATGTTCAGGCGCATTAGACGtttt  AGCCTTTACAGAGATATCAACGGTAAAGTTAGAATACATAAA  ttttTGTAAATCGAATAAACAAtttt  ttttTTAGACTTTCCTTGCTTCtttt  TGAATAAACAAACATGAGGATTTAGAAGTAtttt  AACGTCAAAAATGAGAACAAGGAATATACGATAGCACCTTTTTTATTAA  ACCCTGAATTATACTGACAAGAGCATCGAGTGTTGTTCCAGT  ATATGTAGAAGAATGCGAATTCCACACAACAAGGGTTG  CCGAGATTACGAGCTGGTGCTGCGGCCACGTCAGCGTAATCT  GAATAGCCCGATTTAGAGCTTAACCGTTAGTAATA  CAACTGTCAGTTGGTGGTCTGCACTCTGCGGAAGCATAAAGTATCAAAA  TTCAGAAAAAACGAGACCAGGACTAAAGAAAATCCCTTATAA  TGCCAAGAATCAGTGTCCTGGGGTGCCTAATAATCGGC  CGCTCACGCGGGCCGTTTTCAGAACGTGTATTCATTTAAGAA  GTAAAGCACTGCGCGCCTGTGGTCAGCAGCTGGCT  GTTCCGAGAGTGAGCAGACGATCCAGCGGCCAACG  ATCAAGAGTGGTGCGCGGTTGTGTACATCGAC  ATGAACGGCAGCACGGATCAAACTTAAATTTC  AACCGGACCGGACTAAAAAATCCCGTAAAACCAGG  TACCTTTTTGCGGGTATTCAACCGTTCTAAACGGCCCATTCGCCATTCA  CGCATAGGCAACCGTCATTTGCCGCCAGTGGGAAG  TGGCTTACTAAATCGCTATTTTTGAGAGAAATGTGGGTGCGGGCCTCTT  GACGTTGAAAATCAGGCTGCGTTCTCCGTGGGAAC  CCCTTATATCACCGATAAGAGCATTATGAAATTAATGCCGGACGTCGGA  CTGGCTCCTATTATCAAAGCGGGATTGACCGTAATAATATGA  AGCTGATACCCTGTAATACTTAATTGCT  CGTTAATAACGAGAGGCGATCAGCGAGTAACAACCGAGGGTA  GGTTGTACCAAAAAGTCATTTTAAATCAGGAAGAAGACCTTCACGGCTA  CGCTATTCTTTCATCAACATTATCTACACTCAGAGCATAAAGGAGCTTA  AGTCAGATAGAGAGGAATTAGATAACCC  GGTCTTTCCTTTTGTCACCGAAAGCCCAATAAGAAACGATTTATCCTAA  ATGACCATTGCGGAATTAAAGAAACAAT  CAGTCAGCCTATTTCATAGCCCAGAGGCTTTACGAGCATGTAAATCCAA  AAATCTAATAAACATGCCATCAACGCCAATCAATAATCGGCT  GTGTACAACTAACGGCCTTGAATCACCGTTGAGAACTTATCATTCCAAG  ATCTAAAATATCTTTTATTTAGAGGTGAGAAAGAC  GAACGAGATCAGCTCACCCTCAATTACAAGTCAATAGTGAATATTTAGG  TGAAAGGAATTGAGCCAGTCATCGGTTTGGTAGCA  CAGAGGCAGCCTTTCAGAACCAAACATC  GTCAGTTGGCAAATAAAGGGACAAAAGGTTTGAGG  ACTTTTTCAAAAAACACCACCAGCAAAACCTTTTTAACCTCCGGCTTAA  GTACCGCTGCTTTCCATTGGCGTAATAACATCACTCACTAAA  CCACCCTAATTGTACACGACCGTAGCAATACTTCTGGAGCCC  TCAGAGCAAGGCTCCATTCTGCCATCACGCAAATTGACGGGG  CTGAAACGTTTTCAAATAAGAAAAAATAATATCCC  TAGGAGCTTTTAAAAGTTTGAATTTCATAGGTTTATATTATT  TTTGTTTACAAGAATTGAGTTCTTGAGCTTTCGGTCGGAACC  GAAGGTTTATCATTTTGCGGACAAAATTAGAACCGCCCCCTG  ATAATAAGAGCAAGGTGAATTTAGCGTTGTTAATG  CAACAGTAACCACCAGAAGGAATGAAACGCCACCCTGCCCGT  AACAGCCGAAATAGCAATAGCGACGGAAAATCAAAGTAACAG  TTAGATTAAGACGCAGCCAGTTCGGCATCATTTGG  AATCATAGGTCTGAATTTAACTTTTCATATTATTC  AATGCTTTAAACAGATTGCTGAAATATTTATCTTA  ATATTATTTATCCCGAAACCAACATGTATTATCAAAAGAAAAACAAAGA  CCAGTTACAAAATAGTCTTTCTCGCCATGAGACTAGAAGATGGCGGAAT  ATTTTCGTGAGAAGTTTAACAGTAACAT  TATCATCATATTCCTTACCTGCTCATTTGGTCAGTGAACAAC  AAAGCCGGCGAACGAGTCTGTGCCAACAATATCTG  TCGGAACCCTAAAGTTGATTAAGATTCA  GATGGTGAAAGGAAGGGAAGAAGTGAGGCTGACCT  ACGCCAGAAACAGCCGTCGGTCCTGCATCTAACTCACATTAACCTGTTT  CAGCAGGCGAAAATTTGCGTTCGGTGCCGGTGCCCGGTGCCA  ATGTGCTCTCACGGCAACCAGCAGCCAGGCGCTCACTGCCCGTTTGCCC  ACCACATGACGGTCGGCACCAGCGGTCCACGCTGG  TTGGGTACTCCGTGTGTCCAGCATCAGAGTCGGGAAACCTGTGCAGCAA  GAGAGTTCGTGCCACAAATCGTTAACGGCATCAGCGGGGTCA  CTTTCCATGCCGGGTTACCTGCTTACGG  TTGCAGGTGTTCAGGCTGCATTAATGAA  ACCAACTTCCCACGAAAAAGAGACGCAGCTGGCGA  \*T\*T\*ttttttttttttttttttttttttttttttTTGTGAGAGATAGACTTTACGCCAGGGTTTTCCTCATTTTTTAACC  AATCATACTGGAGGGTGAAGGGATAGCTGCAAGGC  GAACCAGGGAAGGTAATATAAATAAAGCAAGGCTATCAGGTCTAGCCAG  CCGCCTCACATTCAATGTTTTAAGAATTGAGAGTCTGGAGCAAATTCGC  CCCTCAGAGCGCCAAGTACGGATAAATCGAATCGATGAACGGAATAGGA  AAAGATTATATTCAAAGGGGGGTCTGGCCTTCCTGATTGCCT  TAGGAATAATACTGGATTAAGACGCCATCAAAAATAACAAGA  TAATCGTAAAACTAGCATGTCAAATCAGCCAGTCACGACGTT  AGCAAAATTAAGCATGCTGTACCCCTCAATTATTAAGGACAGAAGTTTC  ATACAGGCAAGGCAAAATATGGTCATAACATCAGTCGAACTGAATACGT  AGCATTAACATCCATGTCTGGAGCGTCC  GAGCCACAGAAAATATTCCATTAGTAGT  TTGAATCGCTCAACACCGATTAAGAAAA  CGGAATCCAACTAAAAGACAAGAACAAA  ATGCAGATGTTTAGACTGGATAAGTTTCTCATATGACCGAGG  TTGAAAGCAGGTAGATAAGTTACCGGAAACGCTCAATTAAACCAAGTAC  AGGGAACTGAGATTTGATACAGCCGCCAATTCTTAATCGAGAACAAGCA  AGGCGCATCAACTAAGCGTCAACCCTCAAGTATCATTTATTTTCATCGT  GCCACGCTGAGAGCCTATTAGCAGCGGAACGAAAGCGGAACG  CAAACCCTCAATCAGAGATAGAAATCTCCATGAGG  CATTAAATTTTTTCTAGCAAGATTATTCGTTGGGTTATATAAAAAGCCA  ACCTTGCTGAACCTGAAAGCGATAATAACGGGTAA  AATGCCATAAAGGAATGTACCTACAAAATAAATGCTGATGCATATACAA  AAATGAAAAATCTAACAGACAGAACAACCTACGAA  ACCTAAAGTGAGAACGTCACCTGATTGCTCGCAAGACAAAGACCTGTTT  TCAGGGAACGTTGAAACCCTTCCACCGAGTAAAAGTGGCGAG  GGAACCCATTGCGATAAGAATGTGTTTTTATAATCAAGCGAA  TGAGTTTTAGAAAGATATTTTGGTACGCCAGAATCGGGCGCT  ACTACAAACAGTTTTCTTTAAAAAGGGATTTTAGATCACGCT  TAATTTGCCGAAGCCCTTTTTGAGGGAGAGCCACCTTAACGG  CAAATATCAGATGATGGCAATGAGGCGACCCAATAACTGGTA  AACGAGCGTAAGCAGATAGCCAAGGGCGCCTCAGAGGAGTGT  AAGCATCTATAATCCTGATTGACCAAGTGTAACACCTTTTGA  ATCCTGAGTTACCAGAAGGAAGTTTACCAACCGCCTACATGG  CAGCAGCTATACTTCTGAATAATTCGCCAGTACAATCCAGTA  TTTGCACAAACGCAATAATAAAATCAATCACCCTCTTACCGT  GTCTTTCCAGAGCCAACGGGTACAGTAGGGCTTAGATTTCAATGATTAT  ATCTTACCAACGCTCGCACTCCCAGTATCTATATGTCGCGCATCATCAA  CCAGCTACAATTTTAGCCGTTTATGCGTAATCCAATTTGAATTTTGGAT  AGGAGCGGGCGCTACTGAGAAACGTGGC  GGCAAGTGTAGCGGCAGGAACTGAATGG  CCGCCTGGCCCTGAGCGCGTAACCACCAGCCGATTTGCGCGA  CCCTTCATCGGCCACCCTTACACTGGTGCGCTTTC  AGTTTTGACGAGGCATCCGCGCACTCATCTGATTG  GACGGCCCGCCATGATCCGCCTAAACATACGCGCGGGGAGAGGCAACAG  GAGACGGGCGGTTTTTCTTTGCTCGTCAGGGCGCG  CACCAGTGGGCGCGTACTATGCGTGCTTGAACGAACCACCtttt  ttttGGTTTTTCTTTTCCAAGCGGACGTTAGATCTAA  AACAATCTATGAGCTAAAGGTGCGTATTGGGCGCCAGGGT  TGCGGCTGGTAATGGGCGGGTCAGTATCATTAACCCT  ttttCAACGGAGATTTCTGTTGCCCtttt  ACCTGCTGCACTCATTTACCAGTCCCGGAAT  ttttGGATAACCTCACCGGAGAGCCGCCAAAATATAGATAC  CCCCAGCTAAATTGGTTGCGGGGCGAAACGTACAGAGTGCCA  CATTTGGAAAAGCCCCAAAAATAAACGTAGAGGTG  ttttGACGATAAAAACCACGGGAACtttt  CCACCAGGTTTATTCCAATTCAGGTGGCTGTACCCCGGTTGAAATTCGC  TAATCAGGGCGCGAGCTGAAATGCGAAC  GCTTTTGAGCTTTCTAATATTTTGTTAA  ttttGCAAATATTTAAATTGCAGGAAG  AGGAATTCCAGAGGGTAAAACATTAAATTTTTGTTAATCATA  ttttGTCAATAACCTGATTGTATAAtttt  ATCAATTCTACTAAATAACAGAGTAAAATACATAAACTTAGCAGGCAAA  TTTAGCTATATTTTTGACCATGCGAGAGACTATCACGCCTGAGATTATA  TAGTTAATTTCATCTTAAATACCGCCGCCGCAAAGTTTAGTT  ATACCGACCGTGGGTTGAGGGTGGCAATTTCGCAAATG  GGGTAATTTGATTCTTGTCACCGGAATAAGATTAG  CAAAAGAGAGTAGAACACCACCATGATT  TGCACGTATACAGTATAGTTACATTAAAGAGCAAC  ttttATTGGCCTTGATATTCACACGTTTACCAGACtttt  CCATGTTCGCCAAATCTGAATAGAGCCGATTACTAATTACCGCGCCCAA  TGTCGAAATAGTAAGCCAGAAACCAGAGAGAATAACAAATCAGATATAG  AGAATACACTTTCACGCCTGTAGAAACAAAAACTTTTTCAAAAATCATA  ATTAACACCGCCTGACTGATACTAAACAACTAAAA  CTTTGACTGTATGGAGCCCTCAACAGTA  ttttGTCTTTCCACGAAACAAAGTAtttt  TTCTGACGATGAATAAAACAGAACAGAGGTGAGGCCCATTAAAATTTTC  CACAGACGATTTTGGCCCTAAGAGCTAAACAGGAGCACCCGC  GCGTAACGTAAATGAAATACCTCCTCGTTAGAATCCGCTACA  ttttATTTTCAGGTTTAGTTTTGTCtttt  CAACAGTGGTTAGAACCTACCCATCGGGAGCATTCCGCAGTC  TAAATCACCCAAAAGAACTGGGGAATAAAACCACCTGGAAAG  TTGCGGGAAGACTCCTTATTAAAAGAAACAGCATTAAATCCT  AACAAATGACAGGATGATAAAATCCGGTATTCTAAGAACGtttt  ttttTACATACATAAAGCAGGTCAGACGtttt  ACATATACGCAGTAGCGAACCTCCCGACAAGGCTTTAAGGCG  ttttCGAGGCGTTTTATGTTAGCAAACGTAGAAAAtttt  TTGCTATAGGAATCGAAAAAGACGCGAGATAACGGATGGAAG  AGGTTTTGAAGCCTTAGCAAGACACCGGTATATTTCCTTTTAATATCAA  AACGTCACTAAATTTAATGGTTTGAAtttt  CGCGCTTAATGCGCAGAGCGGAACATCGGGTCAGTAATTATT  ttttAGCAGAAGATAAAAATAAAGAAATTGCGTAGtttt  ttttACGAGCACGTATAAGTTGCTTTGtttt |