Supporting Information

Cavity-type DNA Origami-based Plasmonic Nanostructures for Raman Enhancement

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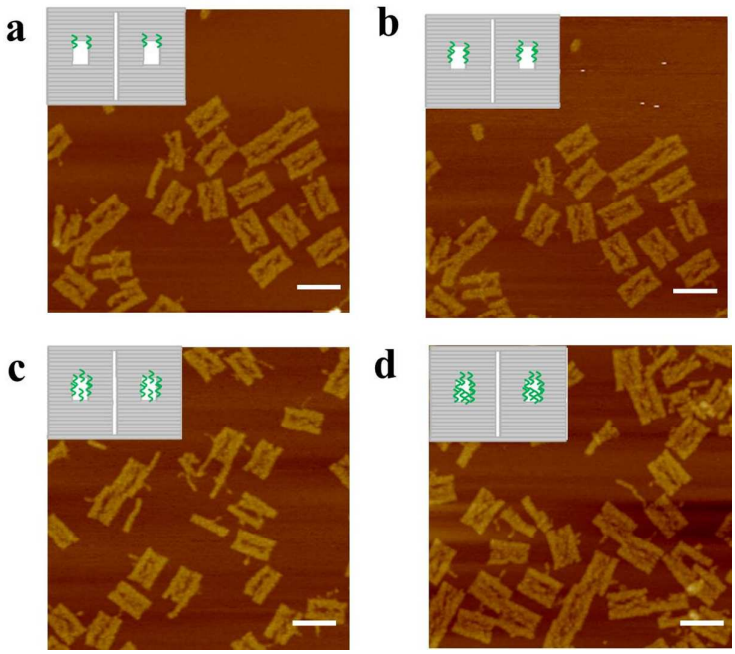


Figure S1. Schematic illustration and AFM images of cavity-type DNA origami with two (a), four (b), six (c), eight (d) capture strands. The scale bars are 100 nm.

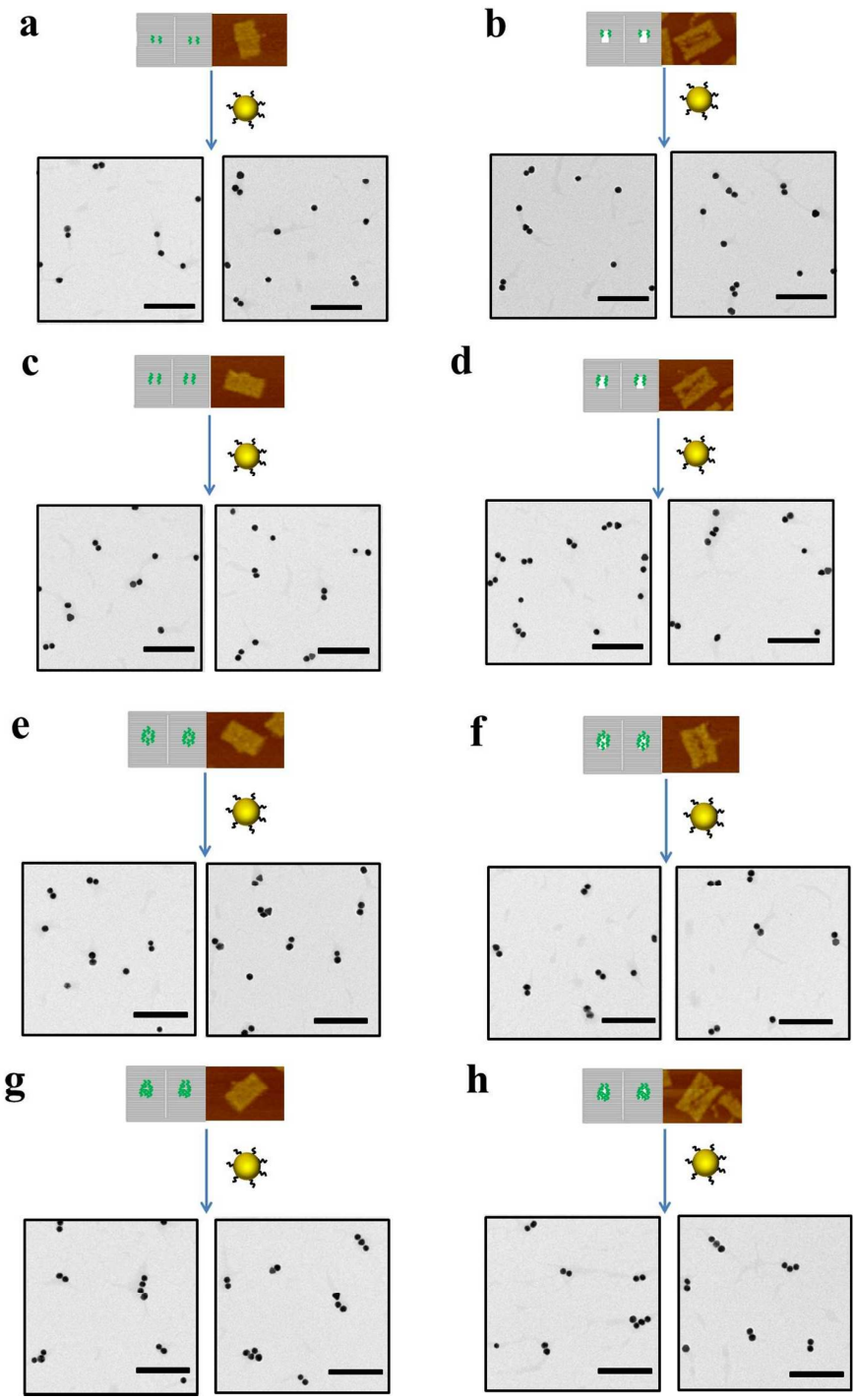
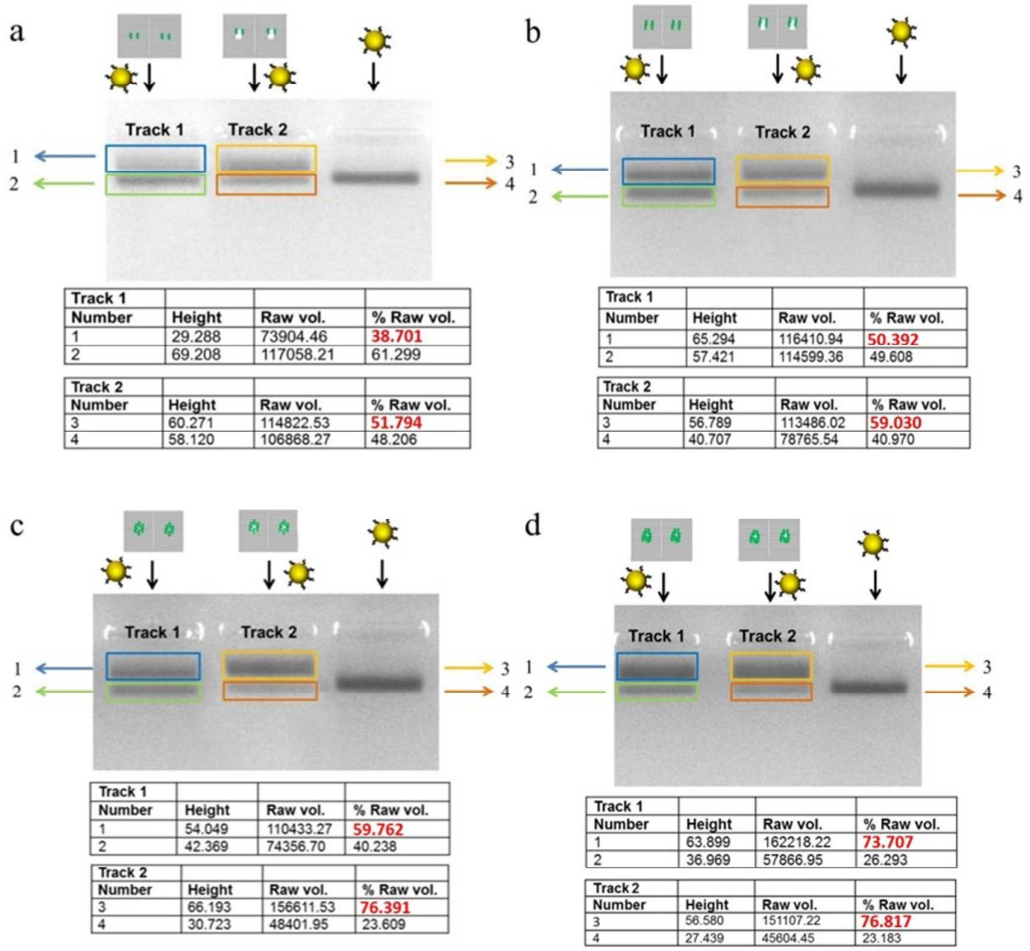


Figure S2. TEM images of AuNPs-dimers based on the rectangular DNA origami and cavity-type DNA origami which carring two (a, b), four (c, d), six (e, f) and eight (g, h) capture strands with the schematic illustration and AFM images of the templates. The scale bars are 200 nm.



Track 1			
Number	Height	Raw vol.	% Raw vol.
1	29.288	73904.46	38.701
2	69.208	117058.21	61.299

Track 2			
Number	Height	Raw vol.	% Raw vol.
3	60.271	114822.53	51.794
4	58.120	106868.27	48.206

Track 1			
Number	Height	Raw vol.	% Raw vol.
1	65.294	116410.94	50.392
2	57.421	114599.36	49.608

Track 2			
Number	Height	Raw vol.	% Raw vol.
3	56.789	113486.02	59.030
4	40.707	78765.54	40.970

Track 1			
Number	Height	Raw vol.	% Raw vol.
1	54.049	110433.27	59.762
2	42.369	74356.70	40.238

Track 2			
Number	Height	Raw vol.	% Raw vol.
3	66.193	156611.53	76.391
4	30.723	48401.95	23.609

Track 1			
Number	Height	Raw vol.	% Raw vol.
1	63.899	162218.22	73.707
2	36.969	57866.95	26.293

Track 2			
Number	Height	Raw vol.	% Raw vol.
3	56.580	151107.22	76.817
4	27.439	45604.45	23.183

Figure S3. Gel electrophoresis and analysis of bands by the software of Gene Tools from Syngene were used to qualify the yields of dimer-AuNPs. Each gel image contained three lanes. One was the DNA-AuNPs as the control. The other two lanes showed the shift of the dimer-AuNPs on the template of rectangular DNA origami and cavity-type DNA origami with different number of capture strands. For the two capture strands on the template of rectangular DNA origami and cavity-type DNA origami, the yields of dimer-AuNPs were 38.701 vs 51.794 (a). For the four capture strands on the template of rectangular DNA origami and cavity-type DNA origami, the yields of dimer-AuNPs were 50.392 vs 59.030 (b). For the six capture strands on the template of rectangular DNA origami and cavity-type DNA origami, the yields of

dimer-AuNPs were 59.762 vs 76.391 (c). For the eight capture strands on the template of rectangular DNA origami and cavity-type DNA origami, the yields of dimer-AuNPs were 73.707 vs 73.817 (d).

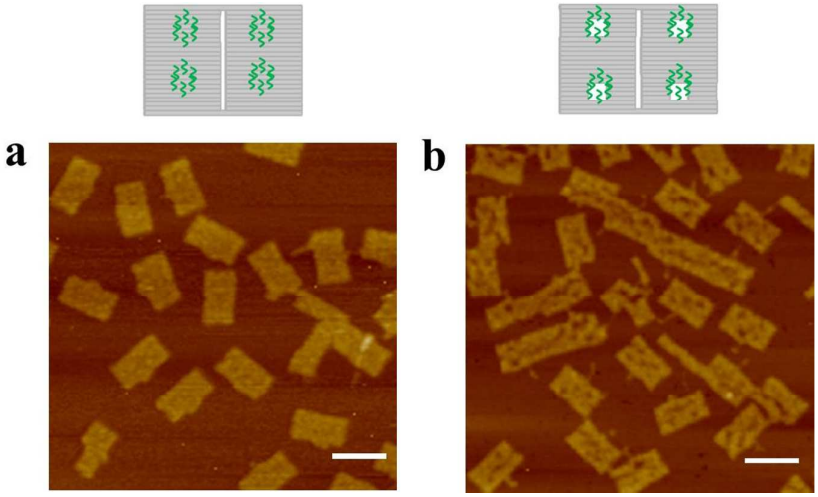


Figure S4. Schematic illustration and AFM images of DNA origami with or without four cavities. The scale bars are 100nm.

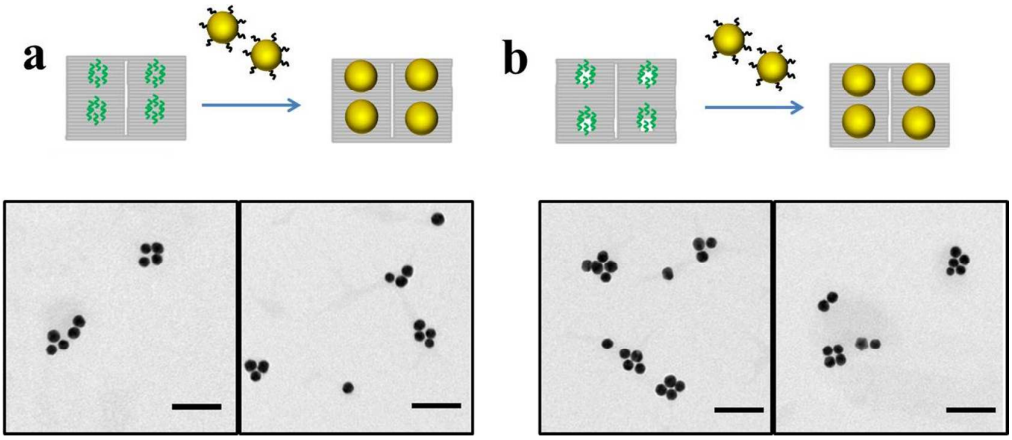
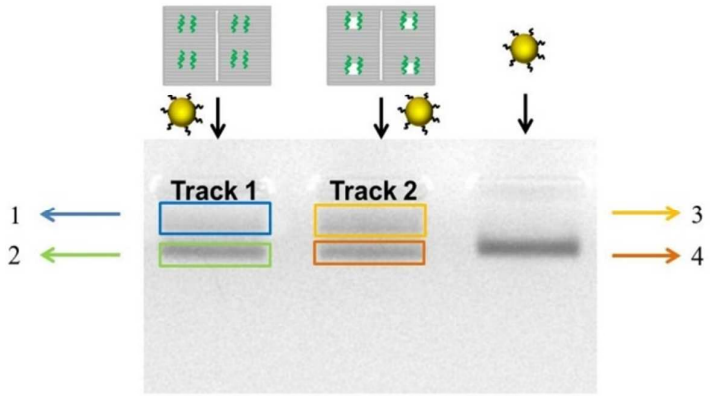


Figure S5. Schematic illustration and TEM images of rectangular (a) and cavity-type (b) DNA origami based tetramer-AuNPs. The scale bars are 100 nm.



Track 1			
Number	Height	Raw vol.	% Raw vol.
1	30.016	43024.05	21.376
2	76.926	158248.62	78.624

Track 2			
Number	Height	Raw vol.	% Raw vol.
3	39.288	85363.09	44.701
4	59.208	105599.58	55.299

Figure S6. Gel electrophoresis and analysis of bands by the software of Gene Tools from Syngene were used to qualify the yields of tetramer-AuNPs. The image contained three lanes. One was the DNA-AuNPs as the control. The other two lanes showed the shift of the tetramer-AuNPs on the template of rectangular DNA origami and cavity-type DNA origami with different number of capture strands. For the six capture strands on the template of rectangular DNA origami and cavity-type DNA origami, the yields of tetramer-AuNPs were 21.376 vs 44.701.

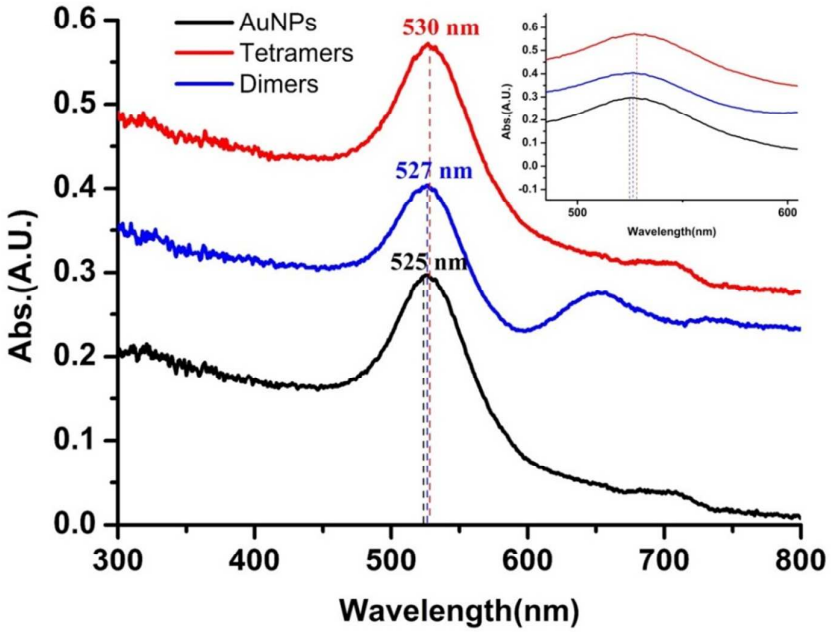


Figure S7. UV-vis absorption of 30 nm AuNPs, dimer-AuNPs and tetramer-AuNPs. The UV-vis absorption of 30 nm AuNPs indicated one well-resolved plasmon peaks in 525 nm. The UV-vis spectrum of dimer-AuNPs displayed a red shift to 527 nm which was accompanied by a small peak at 650 nm. [2]

Calculations of the SERS enhancement factor (EF) of 4-MBA-modified NPs at the hotspots of dimers and tetramer are as follows[1]:

Our pre-prepared concentration of NPs was 4.32 nM.

The surface area of each 30 nm AuNP was calculated as follows: $S= \pi D^2=2826\ nm^2$

4-MBA molecule is about 0.2 nm^2， So the total number of Raman reporter molecule sites on the surface of each 30 nm AuNP was 14130.

Note that the concentration of NTP-modified NPs in the sensing systems was constant. The concentration of 4-MBA-AuNP in dimer = 4.32/2=2.16 nM. The concentration of

4-MBA-AuNP in tetramer equaled to 4.32/4=1.08 nM.

The equivalent concentration of ligands on NPs in dimer solution = 2.16× 14130 = 30520.8 nM.

The equivalent concentration of ligands on NPs in tetramer solution = 1.08× 14130 =15260.4 nM.

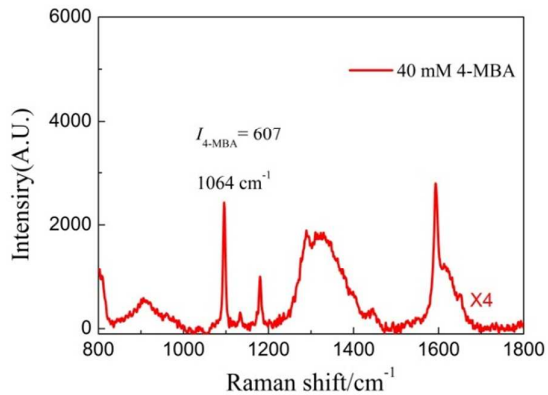


Figure S8. Raman spectrum of 40 mM 4-MBA.

To determine the SERS EF, the Raman signals of freestanding NTP in water were used as a reference, where 0.04 M NTP gave a Raman peak at 1064 cm^{-1} with the intensity of 607.

EF of AuNP dimer $EF_{4\text{-MBA in dimers}} = \frac{I_{4-MBA\ in\ dimers}}{I_{4-MBA}} \times \frac{N_{4-MBA}}{N_{4-MBA\ in\ dimers}}$

EF of AuNP tetramer $EF_{4\text{-MBA in dimers}} = \frac{I_{4-MBA\ in\ tetramers}}{I_{4-MBA}} \times \frac{N_{4-MBA}}{N_{4-MBA\ in\ tetramers}}$

The EF of NTP in dimers and tetramer was 3.53×10^3 and 2.5×10^4, respectively.

Sequences of Oligonucleotides Used in This Work

Sequence of staple strands used in the assembly of basic rectangular DNA origami (left to right 5'-3')

1 CAAGCCCAATAGGAAC CCATGTACAAACAGTT

2 AATGCCCCGTAACAGT GCCCGTATCTCCCTCA

3 TGCCTTGACTGCCTAT TTCGGAACAGGGATAG

4 GAGCCGCCCCACCACC GGAACCGCGACGGAAA

5 AACCAGAGACCCTCAG AACCGCCAGGGGTCAG

6 TTATTCATAGGGAAGG TAAATATT CATTCAGT

7 CATAACCCGAGGCATA GTAAGAGC TTTTTAAG

8 ATTGAGGGTAAAGGTG AATTATCAATCACCGG

9 AAAAGTAATATCTTAC CGAAGCCCTTCCAGAG

10 GCAATAGCGCAGATAG CCGAACAATTCAACCG

11 CCTAATTTACGCTAAC GAGCGTCTAATCAATA

12 TCTTACCAGCCAGTTA CAAAATAAATGAAATA

13 ATCGGCTGCGAGCATG TAGAAACCTATCATAT

14 CTAATTTATCTTTCCT TATCATTCATCCTGAA

15 GCGTTATAGAAAAAGC CTGTTTAG AAGGCCGG

16 GCTCATTTTCGCATTA AATTTTTG AGCTTAGA

17 AATTACTACAAATTCT TACCAGTAATCCCATC

18 TTAAGACGTTGAAAAC ATAGCGATAACAGTAC

19 TAGAATCCCTGAGAAG AGTCAATAGGAATCAT

20 CTTTTACACAGATGAA TATACAGTAAACAATT

21 TTTAACGTTCGGGAGA AACAATAATTTTCCCT

22 CGACAACTAAGTATTA GACTTTACAATACCGA

23 GGATTTAGCGTATTAA ATCCTTTGTTTTCAGG

24 ACGAACCAAAACATCG CCATTAAA TGGTGGTT

25 GAACGTGGCGAGAAAG GAAGGGAA CAAACTAT

26 TAGCCCTACCAGCAGA AGATAAAAACATTTGA

27 CGGCCTTGCTGGTAAT ATCCAGAACGAACTGA

28 CTCAGAGCCACCACCC TCATTTTCCTATTATT

29 CTGAAACAGGTAATAA GTTTTAACCCCTCAGA

30 AGTGTACTTGAAAGTA TTAAGAGGCCGCCACC

31 GCCACCACTCTTTTCA TAATCAAACCGTCACC

32 GTTTGCCACCTCAGAG CCGCCACCGATACAGG

33 GACTTGAGAGACAAAA GGGCGACAAGTTACCA

34 AGCGCCAACCATTTGG GAATTAGATTATTAGC

35 GAAGGAAAATAAGAGC AAGAAACAACAGCCAT

36 GCCCAATACCGAGGAA ACGCAATAGGTTTACC

37 ATTATTTAACCCAGCT ACAATTTTCAAGAACG

38 TATTTTGCTCCCAATC CAAATAAGTGAGTTAA

39 GGTATTAAGAACAAGA AAAATAATTAAAGCCA

40 TAAGTCCTACCAAGTA CCGCACTCTTAGTTGC

41 ACGCTCAAAATAAGAA TAAACACCGTGAATTT

42 AGGCGTTACAGTAGGG CTTAATTGACAATAGA

43 ATCAAAATCGTCGCTA TTAATTAACGGATTCG

44 CTGTAAATCATAGGTC TGAGAGACGATAAATA

45 CCTGATTGAAAGAAAT TGCGTAGACCCGAACG

46 ACAGAAATCTTTGAAT ACCAAGTTCCTTGCTT

47 TTATTAATGCCGTCAA TAGATAATCAGAGGTG

48 AGATTAGATTTAAAAG TTTGAGTACACGTAAA

49 AGGCGGTCATTAGTCT TTAATGCGCAATATTA

50 GAATGGCTAGTATTAA CACCGCCTCAACTAAT

51 CCGCCAGCCATTGCAA CAGGAAAAATATTTTT

52 CCCTCAGAACCGCCAC CCTCAGAACTGAGACT

53 CCTCAAGAATACATGG CTTTTGATAGAACCAC

54 TAAGCGTCGAAGGATT AGGATTAGTACCGCCA

55 CACCAGAGTTCGGTCA TAGCCCCCGCCAGCAA

56 TCGGCATTCCGCCGCC AGCATTGACGTTCCAG

57 AATCACCAAATAGAAA ATTCATATATAACGGA

58 TCACAATCGTAGCACC ATTACCATCGTTTTCA

59 ATACCCAAGATAACCC ACAAGAATAAACGATT

60 ATCAGAGAAAGAACTG GCATGATTTTATTTTG

61 TTTTGTTTAAGCCTTA AATCAAGAATCGAGAA

62 AGGTTTTGAACGTCAA AAATGAAAGCGCTAAT

63 CAAGCAAGACGCGCCT GTTTATCAAGAATCGC

64 AATGCAGACCGTTTTT ATTTTCATCTTGCGGG

65 CATATTTAGAAATACC GACCGTGTTACCTTTT

66 AATGGTTTACAACGCC AACATGTAGTTCAGCT

67 TAACCTCCATATGTGA GTGAATAAACAAAATC

68 AAATCAATGGCTTAGG TTGGGTTACTAAATTT

69 GCGCAGAGATATCAAA ATTATTTGACATTATC

70 AACCTACCGCGAATTA TTCATTTCCAGTACAT

71 ATTTTGCGTCTTTAGG AGCACTAAGCAACAGT

72 CTAAAATAGAACAAAG AAACCACCAGGGTTAG

73 GCCACGCTATACGTGG CACAGACAACGCTCAT

74 GCGTAAGAGAGAGCCA GCAGCAAAAAGGTTAT

75 GGAAATACCTACATTT TGACGCTCACCTGAAA

76 TATCACCGTACTCAGG AGGTTTAGCGGGGTTT

77 TGCTCAGTCAGTCTCT GAATTTACCAGGAGGT

78 GGAAAGCGACCAGGCG GATAAGTGAATAGGTG

79 TGAGGCAGGCGTCAGA CTGTAGCGTAGCAAGG

80 TGCCTTTAGTCAGACG ATTGGCCTGCCAGAAT

81 CCGGAAACACACCACG GAATAAGTAAGACTCC

82 ACGCAAAGGTCACCAA TGAAACCAATCAAGTT

83 TTATTACGGTCAGAGG GTAATTGAATAGCAGC

84 TGAACAAACAGTATGT TAGCAAACTAAAAGAA

85 CTTTACAGTTAGCGAA CCTCCCGACGTAGGAA

86 GAGGCGTTAGAGAATA ACATAAAAGAACACCC

87 TCATTACCCGACAATA AACAACATATTTAGGC

88 CCAGACGAGCGCCCAA TAGCAAGCAAGAACGC

89 AGAGGCATAATTTCAT CTTCTGACTATAACTA

90 TTTTAGTTTTTCGAGC CAGTAATAAATTCTGT

91 TATGTAAACCTTTTTT AATGGAAAAATTACCT

92 TTGAATTATGCTGATG CAAATCCACAAATATA

93 GAGCAAAAACTTCTGA ATAATGGAAGAAGGAG

94 TGGATTATGAAGATGA TGAAACAAAATTTCAT

95 CGGAATTATTGAAAGG AATTGAGGTGAAAAAT

96 ATCAACAGTCATCATA TTCCTGATTGATTGTT

97 CTAAAGCAAGATAGAA CCCTTCTGAATCGTCT

98 GCCAACAGTCACCTTG CTGAACCTGTTGGCAA

99 GAAATGGATTATTTAC ATTGGCAGACATTCTG

100 TTTT TATAAGTA TAGCCCGGCCGTCGAG

101 AGGGTTGA TTTT ATAAATCC TCATTAAATGATATTC

102 ACAAACAA TTTT AATCAGTA GCGACAGATCGATAGC

103 AGCACCGT TTTT TAAAGGTG GCAACATAGTAGAAAA

104 TACATACA TTTT GACGGGAG AATTAACTACAGGGAA

105 GCGCATTA TTTT GCTTATCC GGTATTCTAAATCAGA

106 TATAGAAG TTTT CGACAAAA GGTAAAGTAGAGAATA

107 TAAAGTAC TTTT CGCGAGAA AACTTTTTATCGCAAG

108 ACAAAGAA TTTT ATTAATTA CATTTAACACATCAAG

109 AAAACAAA TTTT TTCATCAA TATAATCCTATCAGAT

110 GATGGCAA TTTT AATCAATA TCTGGTCACAAATATC

111 AAACCCTC TTTT ACCAGTAA TAAAAGGGATTCACCA GTCACACG TTTT

112 CCGAAATCCGAAAATC CTGTTTGAAGCCGGAA

113 CCAGCAGGGGCAAAAT CCCTTATAAAGCCGGC

114 GCATAAAGTTCCACAC AACATACGAAGCGCCA

115 GCTCACAATGTAAAGC CTGGGGTGGGTTTGCC

116 TTCGCCATTGCCGGAA ACCAGGCATTAAATCA

117 GCTTCTGGTCAGGCTG CGCAACTGTGTTATCC

118 GTTAAAATTTTAACCA ATAGGAACCCGGCACC

119 AGACAGTCATTCAAAA GGGTGAGAAGCTATAT

120 AGGTAAAGAAATCACC ATCAATATAATATTTT

121 TTTCATTTGGTCAATA ACCTGTTTATATCGCG

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129 AAACGAAATGACCCCC AGCGATTATTCATTAC

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132 TGAGTTTCGTCACCAG TACAAACTTAATTGTA

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134 GAATAGCCGCAAGCGG TCCACGCTCCTAATGA

135 GAGTTGCACGAGATAG GGTTGAGTAAGGGAGC

136 GTGAGCTAGTTTCCTG TGTGAAATTTGGGAAG

137 TCATAGCTACTCACAT TAATTGCGCCCTGAGA

138 GGCGATCGCACTCCAG CCAGCTTTGCCATCAA

139 GAAGATCGGTGCGGGC CTCTTCGCAATCATGG

140 AAATAATTTTAAATTG TAAACGTTGATATTCA

141 GCAAATATCGCGTCTG GCCTTCCTGGCCTCAG

142 ACCGTTCTAAATGCAA TGCCTGAGAGGTGGCA

143 TATATTTTAGCTGATA AATTAATGTTGTATAA

144 TCAATTCTTTTAGTTT GACCATTACCAGACCG

145 CGAGTAGAACTAATAG TAGTAGCAAACCCTCA

146 GAAGCAAAAAAGCGGA TTGCATCAGATAAAAA

147 TCAGAAGCCTCCAACA GGTCAGGATCTGCGAA

148 CCAAAATATAATGCAG ATACATAAACACCAGA

149 CATTCAACGCGAGAGG CTTTTGCATATTATAG

150 ACGAGTAGTGACAAGA ACCGGATATACCAAGC

151 AGTAATCTTAAATTGG GCTTGAGAGAATACCA

152 GCGAAACATGCCACTA CGAAGGCATGCGCCGA

153 ATACGTAAAAGTACAA CGGAGATTTCATCAAG

154 CAATGACACTCCAAAA GGAGCCTTACAACGCC

155 AAAAAAGGACAACCAT CGCCCACGCGGGTAAA

156 TGTAGCATTCCACAGA CAGCCCTCATCTCCAA

157 GTAAAGCACTAAATCG GAACCCTAGTTGTTCC

158 AGTTTGGAGCCCTTCA CCGCCTGGTTGCGCTC

159 AGCTGATTACAAGAGT CCACTATTGAGGTGCC

160 ACTGCCCGCCGAGCTC GAATTCGTTATTACGC

161 CCCGGGTACTTTCCAG TCGGGAAACGGGCAAC

162 CAGCTGGCGGACGACG ACAGTATCGTAGCCAG

163 GTTTGAGGGAAAGGGG GATGTGCTAGAGGATC

164 CTTTCATCCCCAAAAA CAGGAAGACCGGAGAG

165 AGAAAAGCAACATTAA ATGTGAGCATCTGCCA

166 GGTAGCTAGGATAAAA ATTTTTAGTTAACATC

167 CAACGCAATTTTTGAG AGATCTACTGATAATC

168 CAATAAATACAGTTGA TTCCCAATTTAGAGAG

169 TCCATATACATACAGG CAAGGCAACTTTATTT

170 TACCTTTAAGGTCTTT ACCCTGACAAAGAAGT

171 CAAAAATCATTGCTCC TTTTGATAAGTTTCAT

172 TTTGCCAGATCAGTTG AGATTTAGTGGTTTAA

173 AAAGATTCAGGGGGTA ATAGTAAACCATAAAT

174 TTTCAACTATAGGCTG GCTGACCTTGTATCAT

175 CCAGGCGCTTAATCAT TGTGAATTACAGGTAG

176 CGCCTGATGGAAGTTT CCATTAAACATAACCG

177 TTTCATGAAAATTGTG TCGAAATCTGTACAGA

178 ATATATTCTTTTTTCA CGTTGAAAATAGTTAG

179 AATAATAAGGTCGCTG AGGCTTGCAAAGACTT

180 CGTAACGATCTAAAGT TTTGTCGTGAATTGCG

181 ACCCAAATCAAGTTTT TTGGGGTCAAAGAACG

182 TGGACTCCCTTTTCAC CAGTGAGACCTGTCGT

183 TGGTTTTTAACGTCAA AGGGCGAAGAACCATC

184 GCCAGCTGCCTGCAGG TCGACTCTGCAAGGCG

185 CTTGCATGCATTAATG AATCGGCCCGCCAGGG

186 ATTAAGTTCGCATCGT AACCGTGCGAGTAACA

187 TAGATGGGGGGTAACG CCAGGGTTGTGCCAAG

188 ACCCGTCGTCATATGT ACCCCGGTAAAGGCTA

189 CATGTCAAGATTCTCC GTGGGAACCGTTGGTG

190 TCAGGTCACTTTTGCG GGAGAAGCAGAATTAG

191 CTGTAATATTGCCTGA GAGTCTGGAAAACTAG

192 CAAAATTAAAGTACGG TGTCTGGAAGAGGTCA

193 TGCAACTAAGCAATAA AGCCTCAGTTATGACC

194 TTTTTGCGCAGAAAAC GAGAATGAATGTTTAG

195 AAACAGTTGATGGCTT AGAGCTTATTTAAATA

196 ACTGGATAACGGAACA ACATTATTACCTTATG

197 ACGAACTAGCGTCCAA TACTGCGGAATGCTTT

198 CGATTTTAGAGGACAG ATGAACGGCGCGACCT

199 CTTTGAAAAGAACTGG CTCATTATTTAATAAA

200 GCTCCATGAGAGGCTT TGAGGACTAGGGAGTT

201 ACGGCTACTTACTTAG CCGGAACGCTGACCAA

202 AAAGGCCGAAAGGAAC AACTAAAGCTTTCCAG

203 GAGAATAGCTTTTGCG GGATCGTCGGGTAGCA

204 ACGTTAGTAAATGAAT TTTCTGTAAGCGGAGT

205 TTTT CGATGGCC CACTACGTAAACCGTC

206 TATCAGGG TTTT CGGTTTGC GTATTGGGAACGCGCG

207 GGGAGAGG TTTT TGTAAAAC GACGGCCATTCCCAGT

208 CACGACGT TTTT GTAATGGG ATAGGTCAAAACGGCG

209 GATTGACC TTTT GATGAACG GTAATCGTAGCAAACA

210 AGAGAATC TTTT GGTTGTAC CAAAAACAAGCATAAA

211 GCTAAATC TTTT CTGTAGCT CAACATGTATTGCTGA

212 ATATAATG TTTT CATTGAAT CCCCCTCAAATCGTCA

213 TAAATATT TTTT GGAAGAAA AATCTACGACCAGTCA

214 GGACGTTG TTTT TCATAAGG GAACCGAAAGGCGCAG

215 ACGGTCAA TTTT GACAGCAT CGGAACGAACCCTCAG

216 CAGCGAAAA TTTT ACTTTCA ACAGTTT CTGGGA TTTTGCT AAACTTTT

For assembly of AuNP dimer (left to right 5'-3')

AAAAAAAAAAAAAAA ACCGTTCTAAATGCAA TGCCTGAGAGGTGGCA

AAAAAAAAAAAAAAA TCAATTCTTTTAGTTT GACCATTACCAGACCG

AAAAAAAAAAAAAAA GAAGCAAAAAAGCGGA TTGCATCAGATAAAAA

AAAAAAAAAAAAAAA CCAAAATATAATGCAG ATACATAAACACCAGA

AAAAAAAAAAAAAAA CAACGCAATTTTTGAG AGATCTACTGATAATC

AAAAAAAAAAAAAAA TCCATATACATACAGG CAAGGCAACTTTATTT

AAAAAAAAAAAAAAA CAAAAATCATTGCTCC TTTTGATAAGTTTCAT

AAAAAAAAAAAAAAA AAAGATTCAGGGGGTA ATAGTAAACCATAAAT

AAAAAAAAAAAAAAA GAAGGAAAATAAGAGC AAGAAACAACAGCCAT

AAAAAAAAAAAAAAA ATTATTTAACCCAGCT ACAATTTTCAAGAACG

AAAAAAAAAAAAAAA GGTATTAAGAACAAGA AAAATAATTAAAGCCA

AAAAAAAAAAAAAAA ACGCTCAAAATAAGAA TAAACACCGTGAATTT

AAAAAAAAAAAAAAA ATCAGAGAAAGAACTG GCATGATTTTATTTTG

AAAAAAAAAAAAAAA AGGTTTTGAACGTCAA AAATGAAAGCGCTAAT

AAAAAAAAAAAAAAA AATGCAGACCGTTTTT ATTTTCATCTTGCGGG

AAAAAAAAAAAAAAA AATGGTTTACAACGCC AACATGTAGTTCAGCT

For assembly of AuNP tetramer (left to right 5’-3’)

AAAAAAAAAAAAAAA TTTCATGAAAATTGTG TCGAAATCTGTACAGA

AAAAAAAAAAAAAAA GCGAAACATGCCACTA CGAAGGCATGCGCCGA

AAAAAAAAAAAAAAA AAAGATTCAGGGGGTA ATAGTAAACCATAAAT

AAAAAAAAAAAAAAA ACCGTTCTAAATGCAA TGCCTGAGAGGTGGCA

AAAAAAAAAAAAAAA CCCGGGTACTTTCCAG TCGGGAAACGGGCAAC

AAAAAAAAAAAAAAA GTGAGCTAGTTTCCTG TGTGAAATTTGGGAAG

AAAAAAAAAAAAAAA AGAAAAGCAACATTAA ATGTGAGCATCTGCCA

AAAAAAAAAAAAAAA AAATAATTTTAAATTG TAAACGTTGATATTCA

AAAAAAAAAAAAAAA GCCACCACTCTTTTCA TAATCAAACCGTCACC

AAAAAAAAAAAAAAA TCGGCATTCCGCCGCC AGCATTGACGTTCCAG

AAAAAAAAAAAAAAA GAAGGAAAATAAGAGC AAGAAACAACAGCCAT

AAAAAAAAAAAAAAA ATCAGAGAAAGAACTG GCATGATTTTATTTTG

AAAAAAAAAAAAAAA ATCAAAATCGTCGCTA TTAATTAACGGATTCG

AAAAAAAAAAAAAAA AAATCAATGGCTTAGG TTGGGTTACTAAATTT

AAAAAAAAAAAAAAA TTATTAATGCCGTCAA TAGATAATCAGAGGTG

AAAAAAAAAAAAAAA CTAAAATAGAACAAAG AAACCACCAGGGTTAG

ssDNA1: TTTTTTTTTTTTTTT AGC GA-SH

References:

1. Li, S.; Xu, L.; Ma, W.; Kuang, H.; Wang, L.; Xu, C. Triple Raman Label-Encoded Gold Nanoparticle Trimers for Simultaneous Heavy Metal Ion Detection. Small., 2015, 28, 3435–3439.

2. Chen, G.; Wang, Y.; Yang, M. Measuring ensemble-averaged surface-enhanced Raman scattering in the hotspots of colloidal nanoparticle dimers and trimers. J. Am. Chem. Soc., 2010,132, 3644-3645.