Supporting Information

Geometry Guided Crystallization of Anisotropic DNA Origami Shapes

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I. Materials and Methods

a. Preparation of DNA-functionalized gold nanoparticles (AuNPs)

First, we use tris[2-carboxyethyl] phosphine (TCEP) to break disulfide bond in the 3'-thiolated oligonucleotides (Shanghai Sangon Biotech Co. Ltd). This process is incubated in an ice bath for 1.5 h. Then, we use a size exclusion column (G-25, GE Healthcare) to remove useless small molecules. Next, the monothiol oligonucleotides are mixed with spherical gold nanoparticles (AuNPs) with a diameter of ~10 nm (Ted Pella Inc.) in a molar ratio of 300:1. After 1.5 h, phosphate buffer and sodium dodecyl sulfate (SDS) solution are added to the mixed solution to obtain10 mM phosphate, 0.01% SDS buffer and then the buffer solution is incubated for 1.5 h. In the subsequent salt-aging process, we slowly add NaCl into the mixture until the NaCl concentration reaches 0.3 M. After that, the solution mixture is aged at room temperature for about 18 h. Finally, the mixed solution is centrifuged four times and washed with 10 mM phosphate buffer containing 0.1 M NaCl and 0.01% SDS to remove excessive DNA sequences.

b. Design and synthesis of elongated octahedral DNA origami frames (DOFs)

The design of elongated octahedron DNA origami frames (E-octa DOFs) could be found in the previous report.[1] Briefly, each edge of the E-octa DOFs is composed of a six-helix bundle (6HB), the four edges in the middle plane have the identical length of 84 base-pairs (~28.56 nm), while the other eight edges are elongated to 105 base-pairs (~35.70 nm). For each edge, both ends are designed to protrude one single-stranded (ss) DNA sticky end (SE) for further assembly. Therefore, four SEs are stretched out from each vertex of the E-octa DOF. E-octa DOFs are synthesized by firstly mixing 10 nM M13mp18 scaffold DNA (Bayou Biolabs, LLC), 100 nM of each staple strands and each SE strands (Shanghai Sangon Biotech Co. Ltd) in buffer solution consisting of 1 mM EDTA, 12.5 mM magnesium acetate and 40 mM Tris acetate. Then, the mixed solution is incubated by cooling from 90 ºC to 20 ºC for about 23 h in a PCR device to obtain the designed DNA structures. Details of the models and representative negatively stained transmission electron microscopy (TEM) images of the obtained samples are shown in Figure S1.

c. Fabrication of nanoparticle/DOF lattices

Two kinds of E-octa DOFs which can connect with each other and DNA-functionalized AuNPs are mixed in a molar ratio of 1:1:1.2. The mixed solution is then carefully annealed from 50 ºC to 20 ºC at a rate of 0.2 ºC /h (annealing once or twice) to obtain the lattices. During the secondary annealing, the solution volume is reduced to 20 μL (the original volume is 100 μL).

d. Preparation of silica-coated samples

Firstly, the sample solution is washed with buffer solution (1 mM EDTA, 12.5 mM magnesium acetate and 40 mM Tris acetate) for several times at room temperature to remove excess unassembled DNA sequences. Then, the sample solution is mixed with

0.5-1.2 μL TMAPS (N-trimethoxysilylpropyl-N,N,N-trimethylammonium chloride) and shaken on thermomixer (400 rpm, 20 min, 20 ºC). Subsequently, 0.3-0.9 μL TEOS (tetraethyl orthosilicate) is added followed by shaking for 30 min with 500 rpm at the same temperature. After standing the sample solution for 12 h, we use deionized water to remove excess silica chunks.

II. Electron Microscopy

a. Transmission electron microscopy (TEM) sample preparation and characterization

Firstly, the carbon-coated copper grids are glow discharged for 30 s by PELCO easiGlow instrument (Ted Pella, Inc.). Then, 5 μL sample solution is deposited onto the treated grids for 5 min. The un-dried solution is removed by a piece of filter paper, followed by washing the sample twice with deionized water. Subsequently, the sample is stained by 5 μL 2% (w/v) uranyl acetate aqueous solution for 10 s and the excessive uranyl acetate aqueous is immediately wicked away by a filter paper. The negatively stained samples are observed by JEOL JEM-1400Flash operated at 120 kV.

b. Scanning electron microscopy (SEM) sample preparation and characterization

We drop 3-5 μL silica-coated sample solution onto alcohol-washed silicon wafer and then place the sample under an infrared light until the droplet dried. The prepared samples are observed by HITACHI Regulus 8100. For clarity, portions of the SEM images are false-colored using Adobe Photoshop.

III. Small-Angle X-ray Scattering (SAXS)

For SAXS detecting, approximate 50 μL of the sample solution is transferred into a quartz capillary with the internal diameter about 1 mm. Then, capillaries are sealed with wax for SAXS measurement. Before detecting, capillaries are carefully fixed on the sample stage. The SAXS data are collected at beamlines BL16B1/BL19U2 at Shanghai Synchrotron Radiation Facility (SSRF). The two-dimensional (2D) scattering data are collected with Pilatus 5M detector and integrated into one-dimensional (1D) scattering curve I(q) as a function of the scattering vector q, where $q = 4\frac{\pi}{\lambda}sin(\frac{\theta}{2})$ with λ and θ being the wavelength of the incident X-rays and the scattering angle, respectively.[2] To eliminate the interference from un-aggregated nanoparticles, $I(q)$ is divided by the corresponding particle form factor $P(q)$ to obtain the structure factor $S(q)$.[3] We use PowderCell software to generate simulation data patterns and to confirm the lattice type of the described systems.

IV. Supplementary Figures

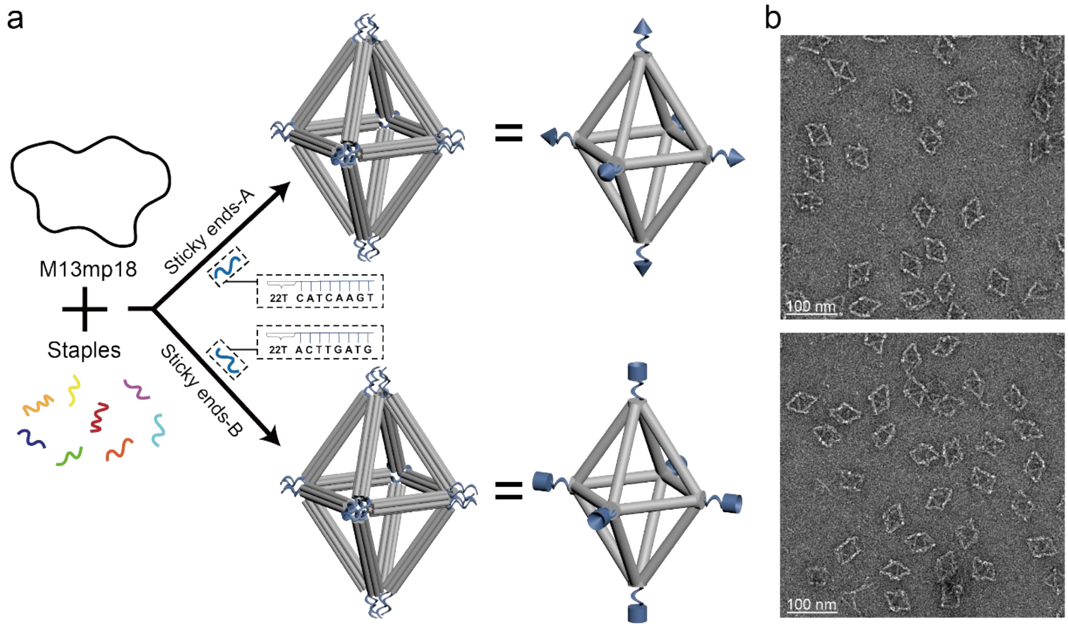

Figure S1. Schematic illustration of the assembly process of E-octa-A/B DOFs with identical sticky ends (SEs). (a) Assembly process of E-octa-A/B DOFs, each edge of a DOF is composed of a six-helix bundle which is represented by a single-helix bundle for easier description. The sequences of complementary SEs are shown and the SEs are exhibited as cones and cylinders. (b) Representative negative-stained transmission electron microscopy (TEM) images of E-octa DOFs.

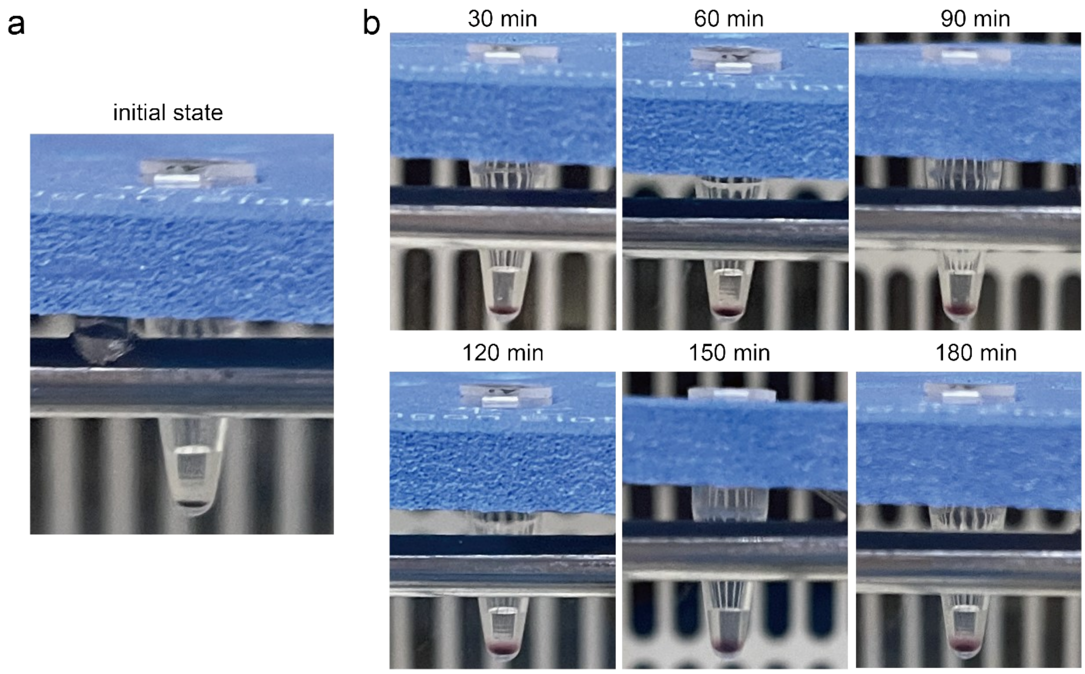

Figure S2. The state of the assembly deposited at the bottom of the tube after the first annealing process. (a) The initial state of the assembly. (b) State of the sample after incubation with different time under the temperature of 50 °C.

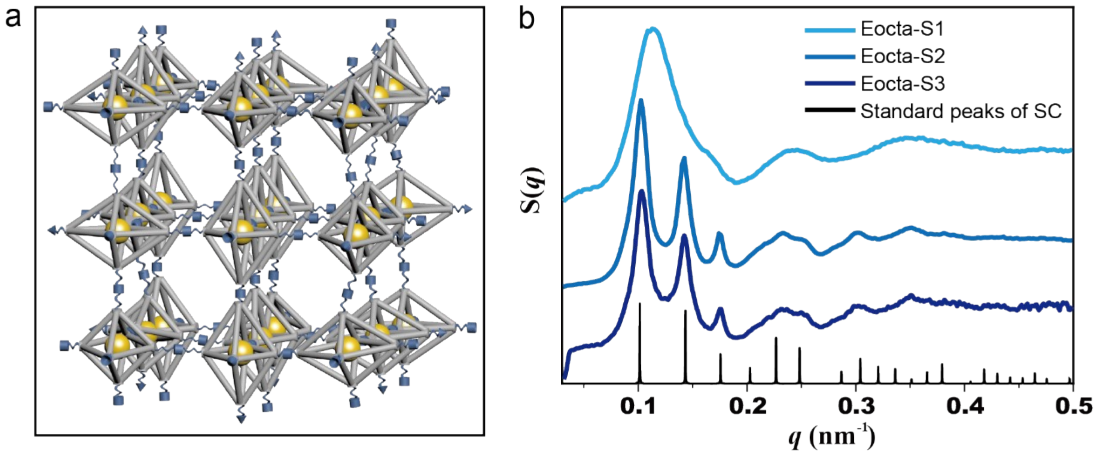

Figure S3. The model of Eocta-S2 and the small-angle X-ray scattering (SAXS) results of different annealing cycles. (a) The proposed model of the superlattice assembled by E-octa DOFs with identical soft SEs. (b) SAXS results for different annealing cycles and standard peaks of simple cubic (SC). The number of annealing cycles from top to bottom is 1 (Eocta-S1), 2 (Eocta-S2) and 3 (Eocta-S3).

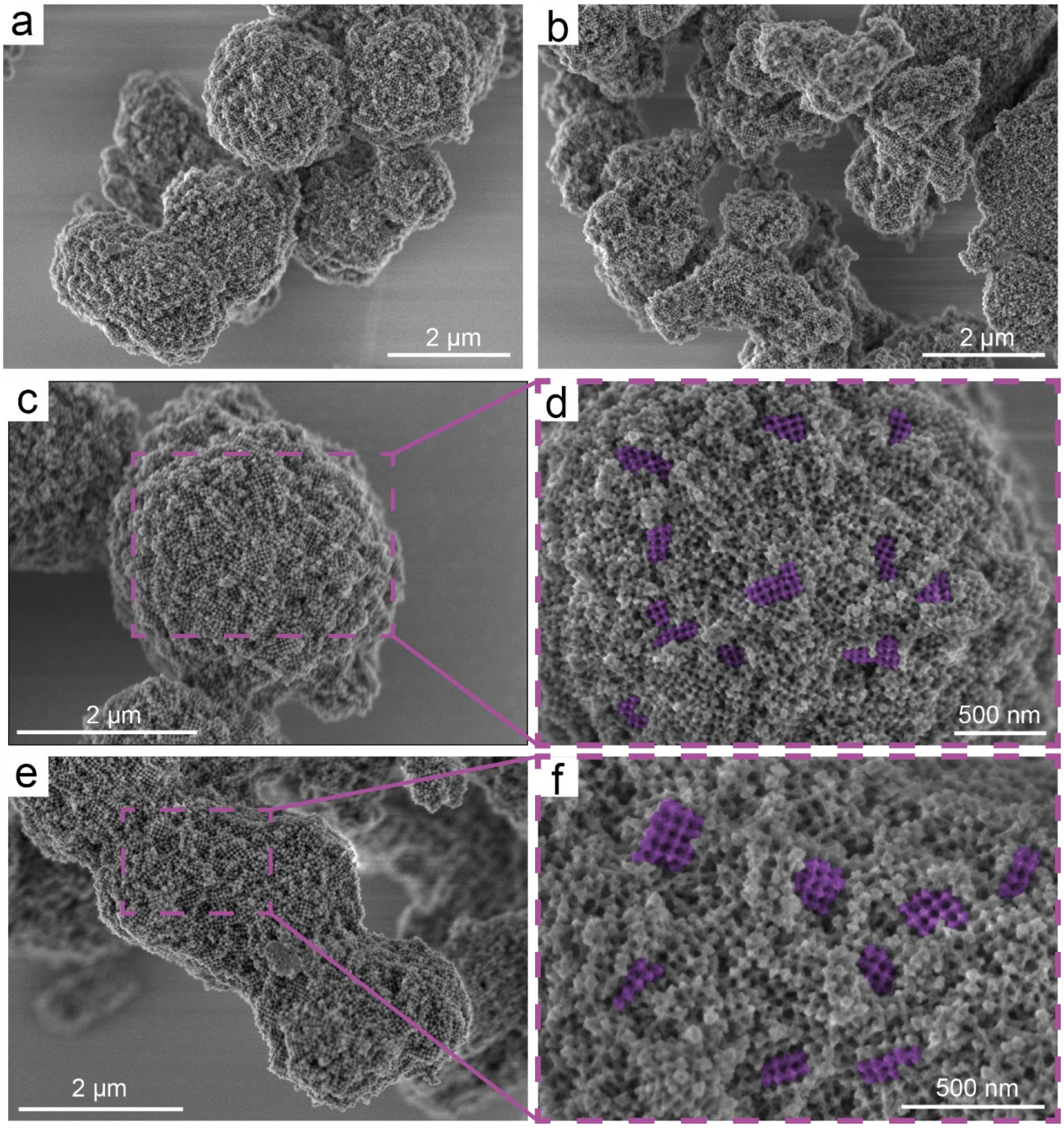

Figure S4. Representative scanning electron microscopy (SEM) images of Eocta-S1 lattices. (a, b) Low-magnification SEM images of microcrystals after silica coating. (c-f) Large-scaled SEM image of crystallites (c, e) and corresponding close-up views of a localized area (d, f). The regions with the grid pattern are colored with false color (purple) for better distinguishing.

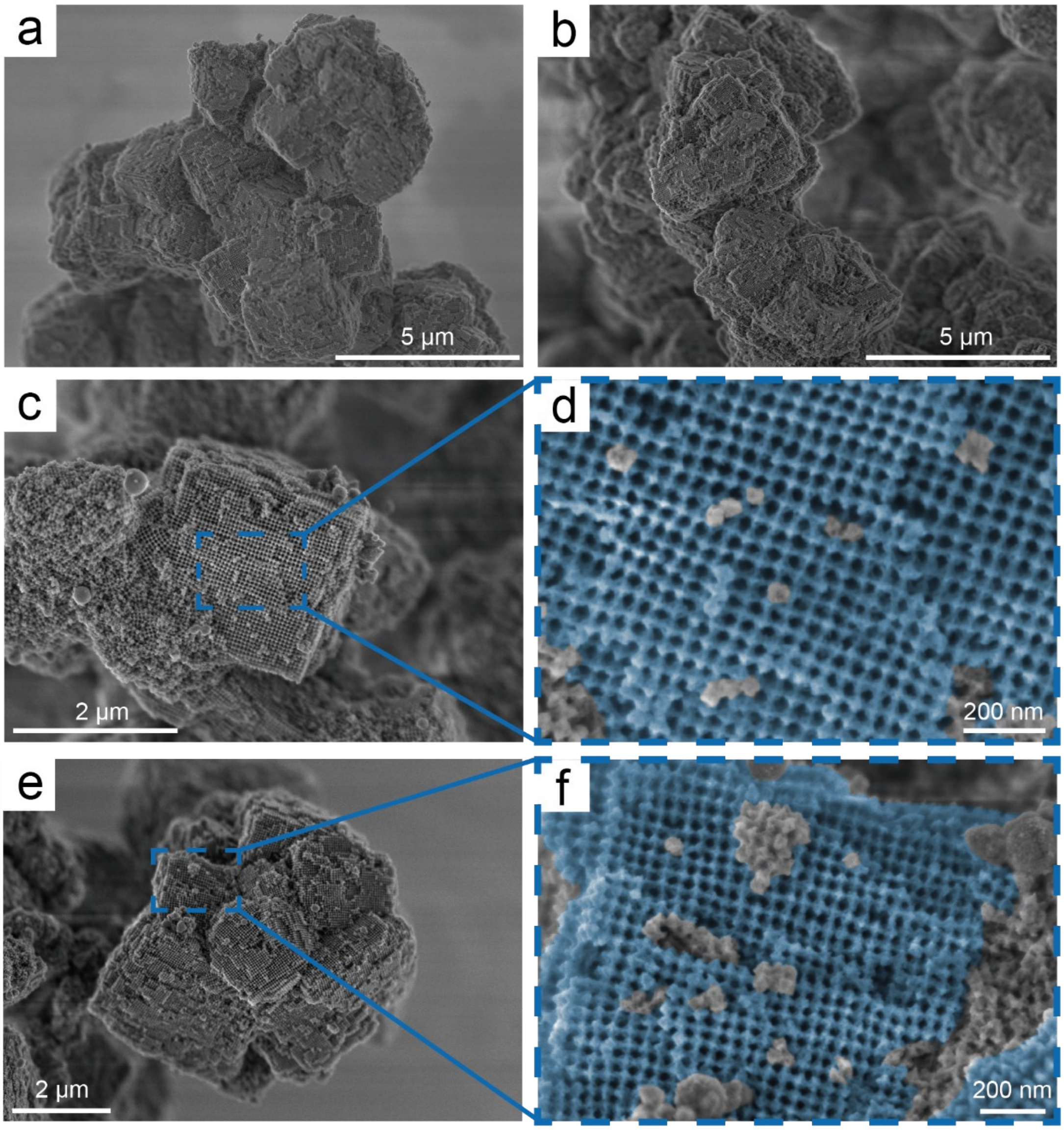

Figure S5. Representative SEM images of Eocta-S2 superlattices. (a, b) Low-magnification SEM images of microcrystals after silica coating. (c-f) Large-scaled SEM image of crystallites (c, e) and corresponding close-up views of a localized area (d, f). The regions with the grid pattern are colored with false color (blue) for better distinguishing.

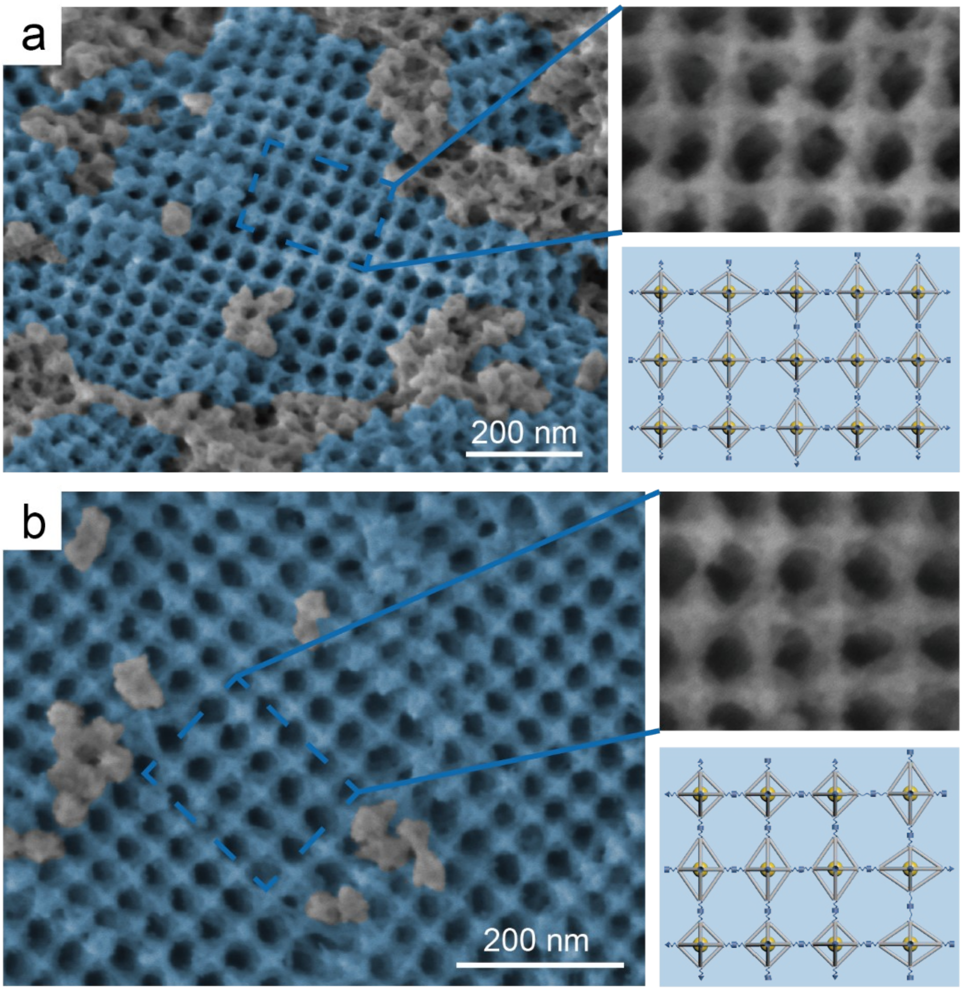

Figure S6. Representative high magnification SEM images of Eocta-S2 superlattices. (a, b) High magnification SEM images of Eocta-S2 superlattices (left), in which the regions with grid pattern are false-colored in blue. Close-up views of the regions framed in the blue dotted box (up-right) and corresponding models (bottom-right).

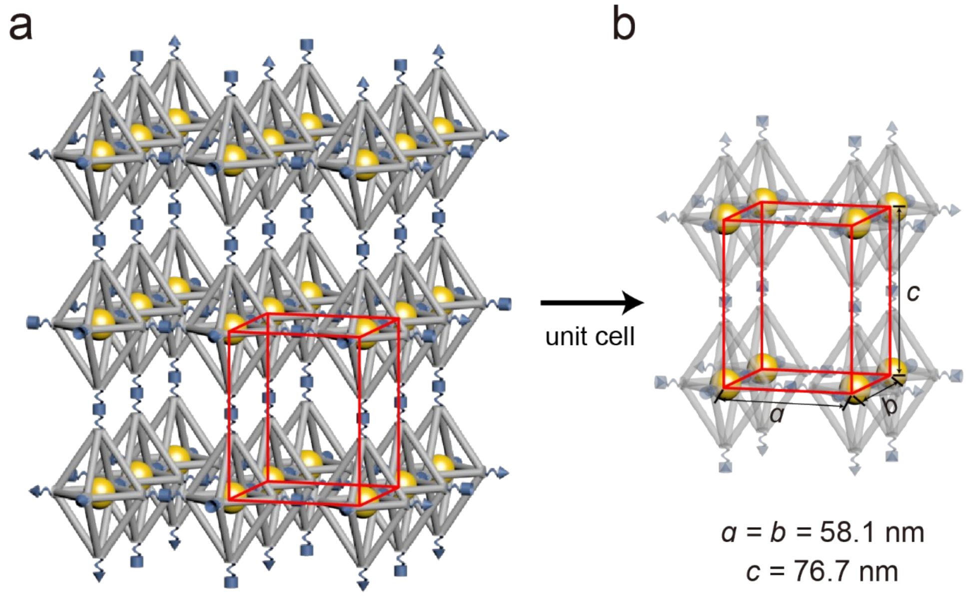

Figure S7. The theoretical lattice parameters of simple tetragonal (ST) composed of E-octa DOFs. (a) In theory, the simple tetragonal (ST) superlattice composed of E-octa DOFs is formed by the translational arrangement of monomers. (b) The theoretical unit cell parameters are $a = b = 58.1$ nm, and $c = 76.7$ nm. The experimental parameters of Eocta-S2 are $a = b = c = 62.0$ nm appropriating the value 64.3 nm, which is calculated by averaging the distance between monomers in three directions (64.3 nm = (58.1 +58.1 + 76.7) / 3 nm). Therefore, we proposed that the E-octa DOFs in the superlattice Eocta-S2 were arbitrarily arranged in the three directions.

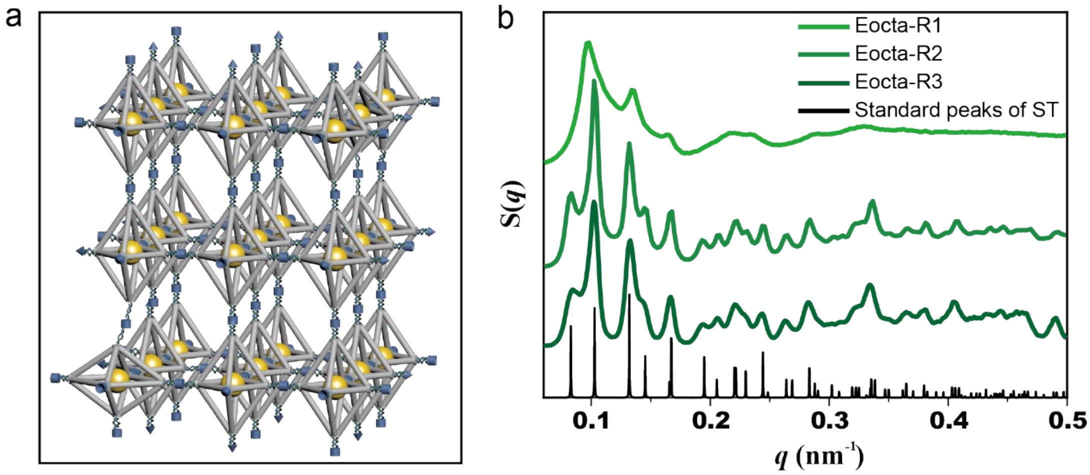

Figure S8. The model of Eocta-R2 and the SAXS results of different annealing cycles. (a) The proposed model of the superlattice assembled by E-octa DOFs with identical rigid SEs. (b) SAXS results for different annealing cycles and standard peaks of ST. The number of annealing cycles from top to bottom is 1 (Eocta-R1), 2 (Eocta-R2) and 3 (Eocta-R3).

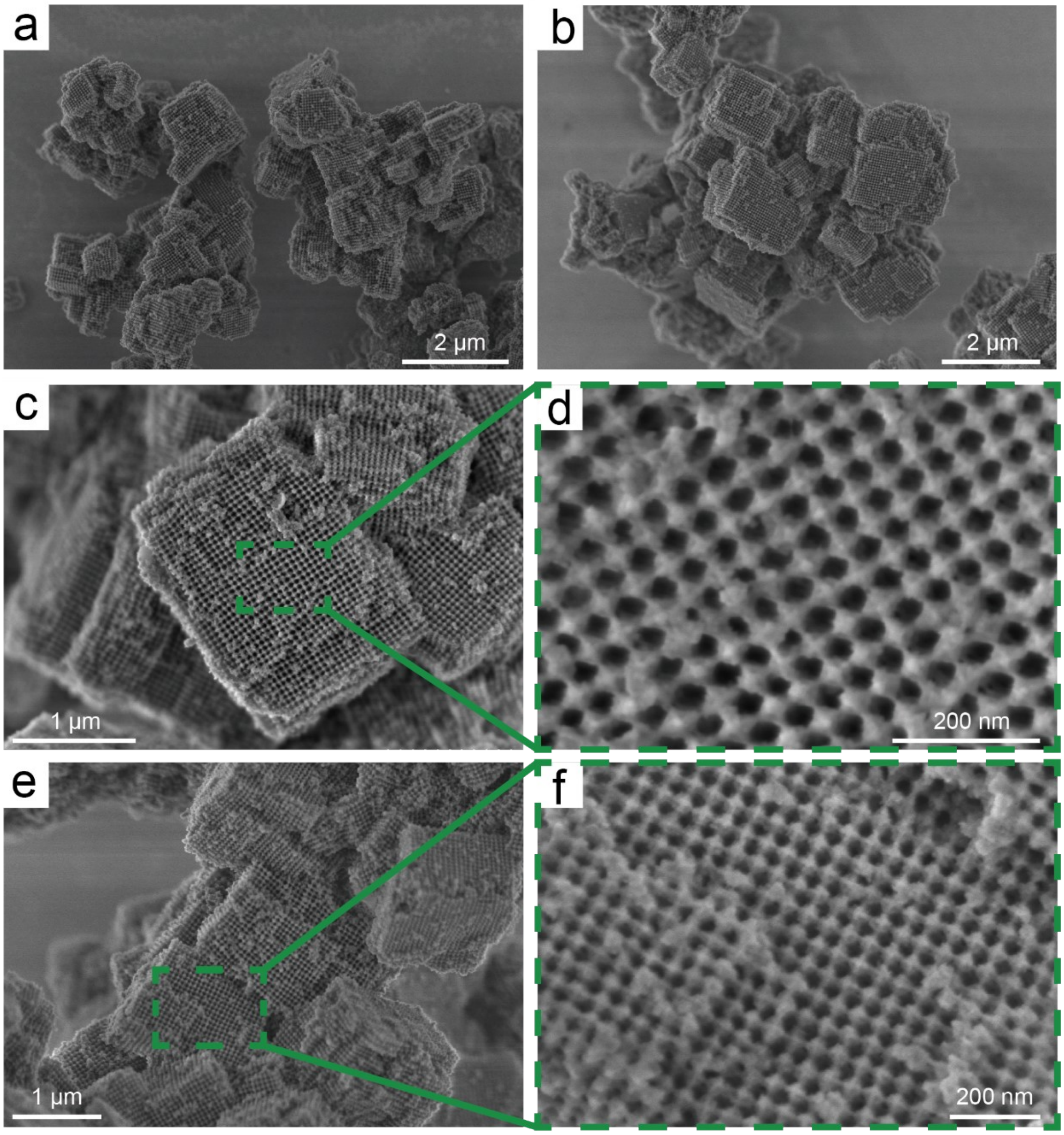

Figure S9. Representative SEM images of Eocta-R2 superlattices. (a, b) Low-magnification SEM images of microcrystals after silica coating. (c-f) Large-scaled SEM image of crystallites (c, e) and corresponding close-up views of a localized area (d, f). The regions with the grid pattern are colored with false color (green) for better distinguishing.

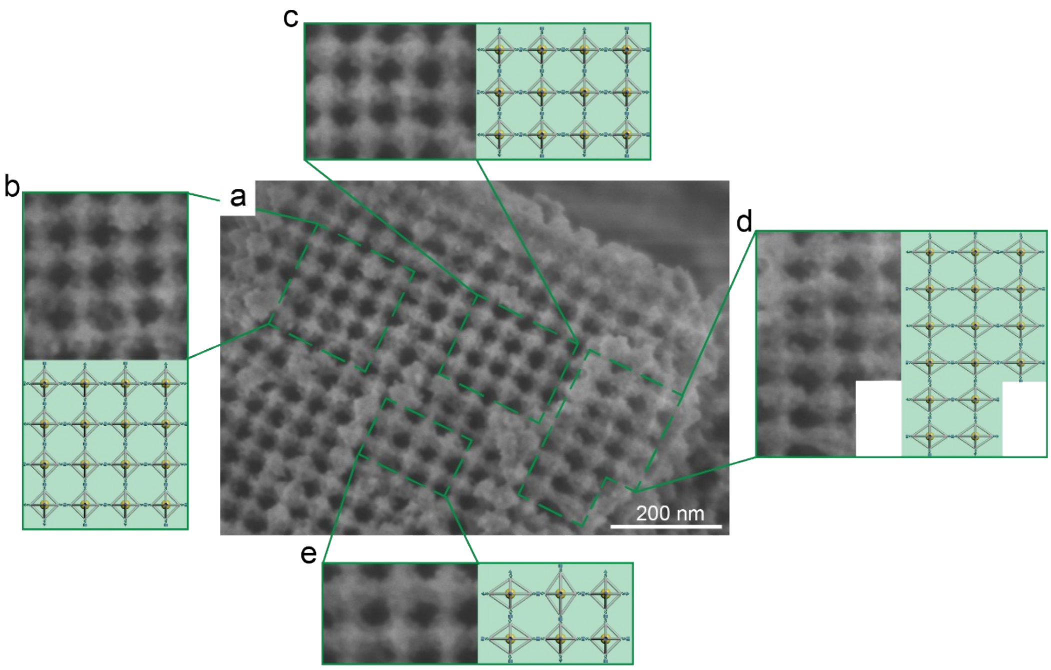

Figure S10. The arrangement of DOFs in the Eocta-R2 superlattice. (a) High magnification SEM images of Eocta-R2 superlattices. (b-e) Close-up views of the regions framed in the green box with corresponding models shown beside. Most monomers are arranged in translational mode and exposed the middle square planes (b, c) or rhombic planes (d). However, there are still a small number of monomers can be found to arrange arbitrarily (e).

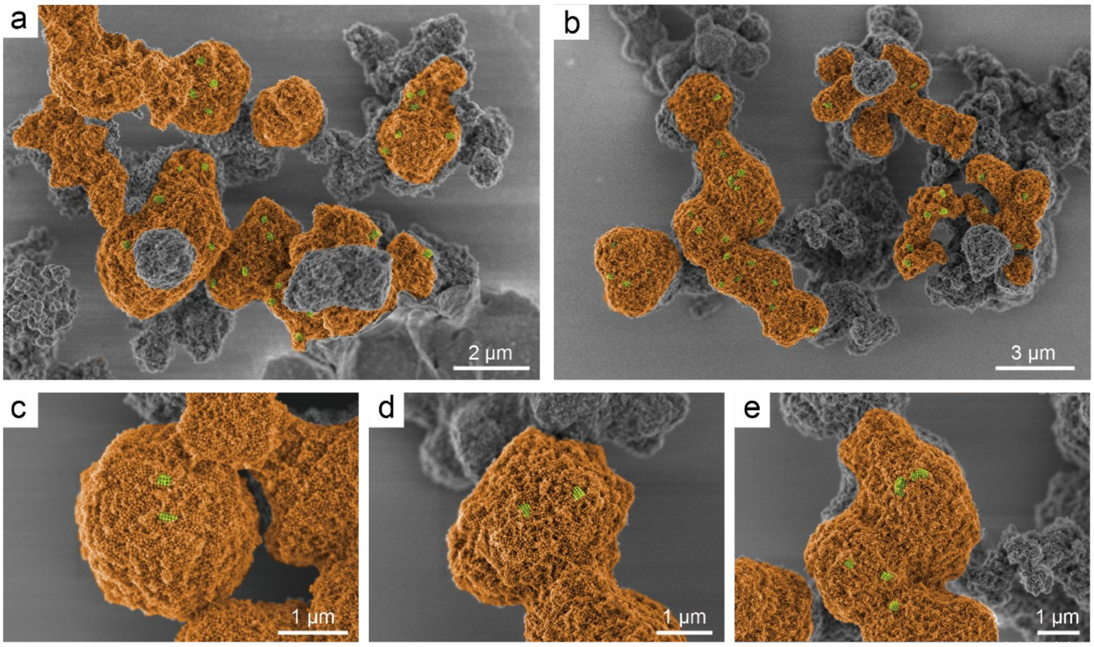

Figure S11. Region classification of Eocta-S1 lattices. (a-e) Low magnification (a, b) and high magnification (c-e) SEM images of Eocta-S1 lattices, the regions of Type I are painted with the orange false color, while the regions of Type II are painted with the yellow false color. Because some grain parts that are not in the focal plane of the SEM cannot be distinguished, these parts are not painted with false color.

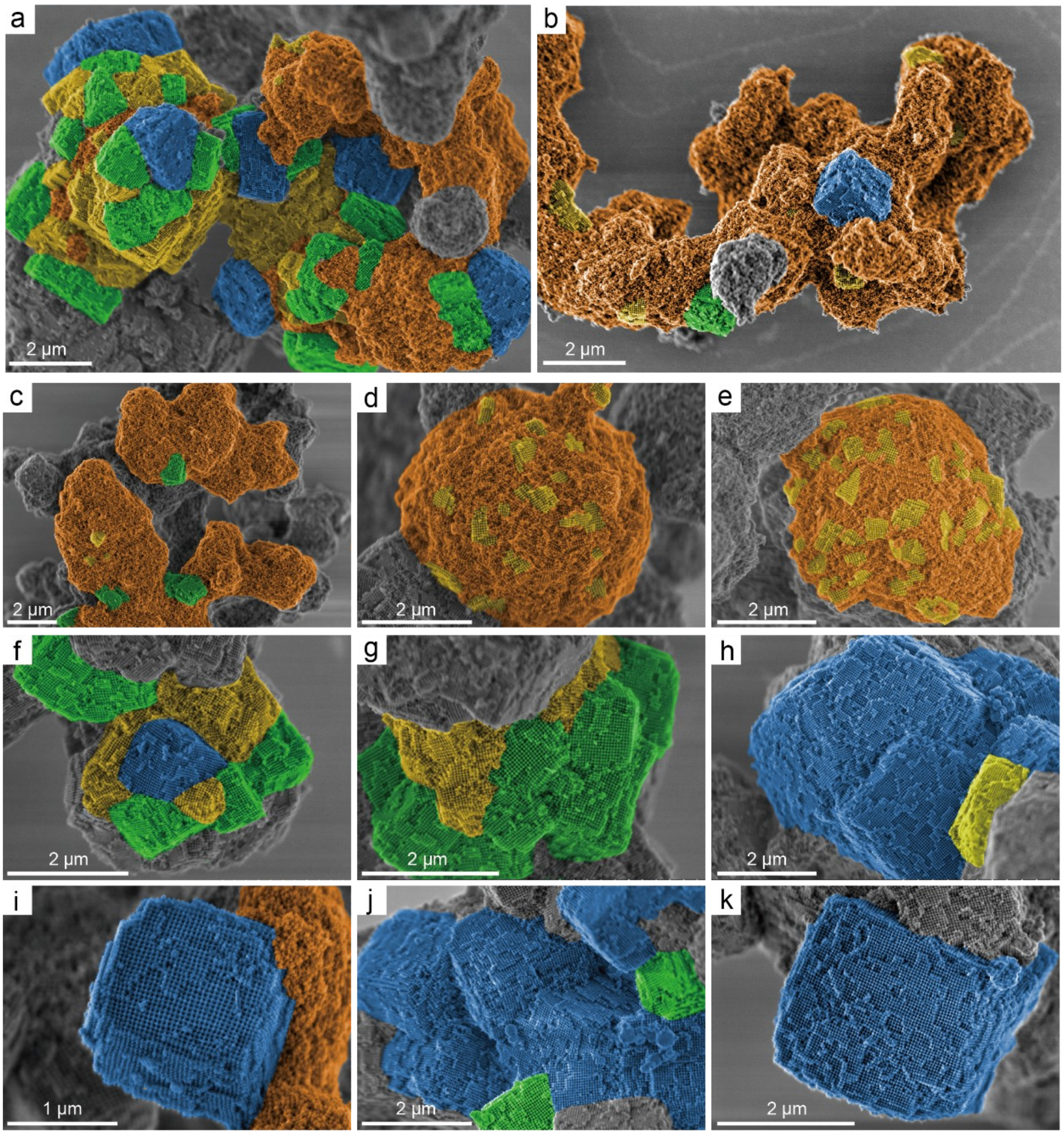

Figure S12. Region classification of Eocta-S2 superlattices. (a-k) Low magnification (a, b) and high magnification (c-k) SEM images of Eocta-S2 superlattices. The regions of Type I, II, III, IV are painted with the orange yellow, green, and blue false color, respectively. Because some grain parts that are not in the focal plane of the SEM cannot be distinguished, these parts are not painted with false color.

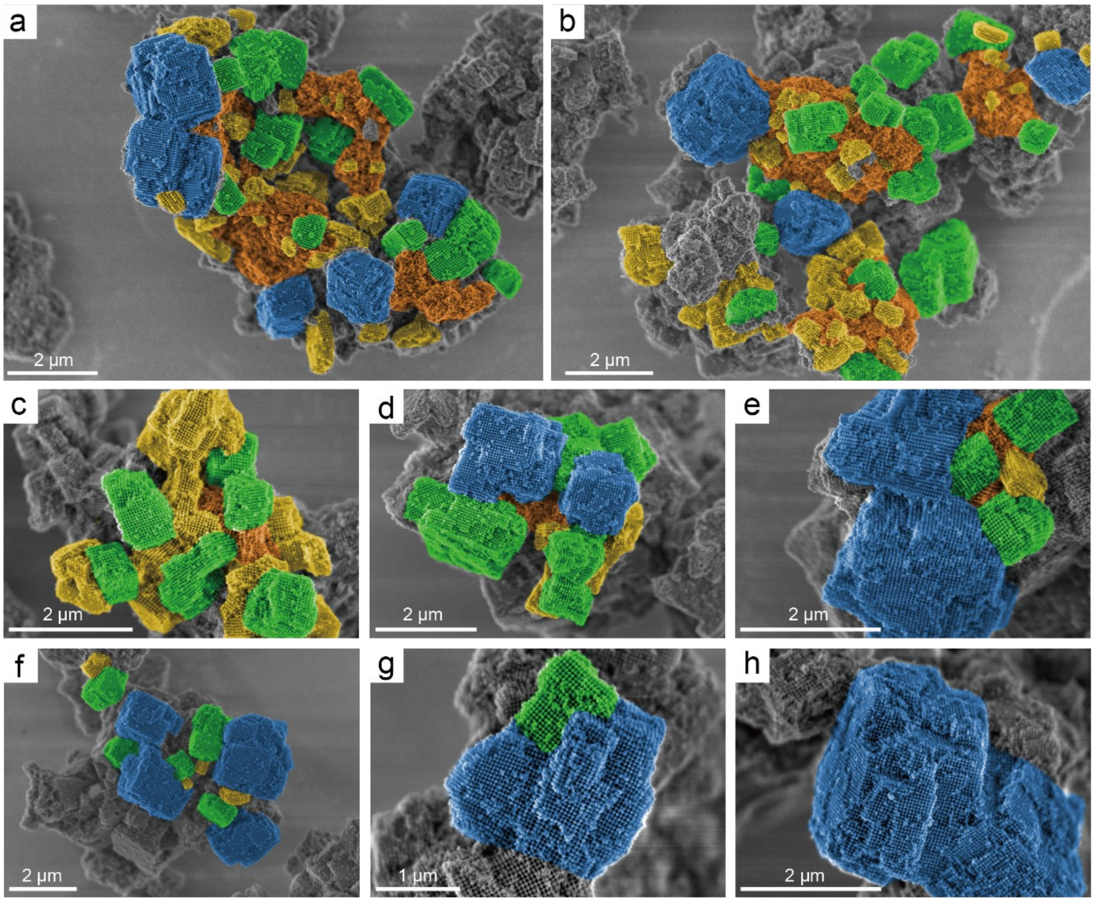

Figure S13. Region Classification of Eocta-R2 superlattices. (a-h) Low magnification (a, b) and high magnification (c-h) SEM images of Eocta-R2 superlattices. The regions of Type I, II, III, IV are painted with the orange, yellow, green, and blue false color, respectively. Because some grain parts that are not in the focal plane of the SEM cannot be distinguished, these parts are not painted with false color.

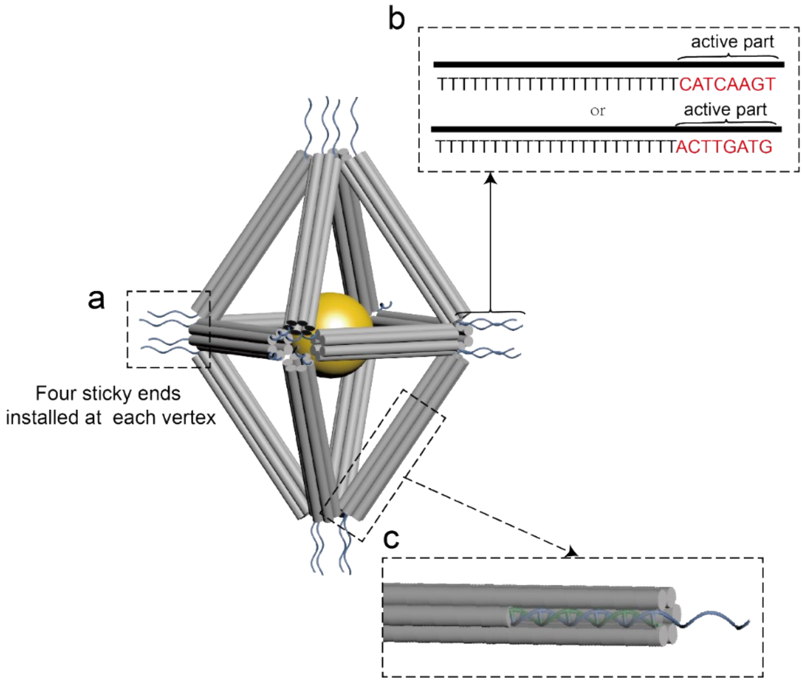

Figure S14. Detailed schematic illustration of the SEs installed in the E-octa DOFs. (a) Each vertex of the E-octa is designed to protrude four sticky ends. (b) The exact sequences of the SEs are “TTTTTTTTTTTTTTTTTTTTTTCATCAAGT” or “TTTTTTTTTTTTTTTTTTTTTTACTTGATG”, both with the end eight bases (red) playing the role of connecting. (c) To link the SEs to E-octa DOFs, long DNA strands, composed of the sequence of SEs and the sequence that can be connected to the scaffold, are used.

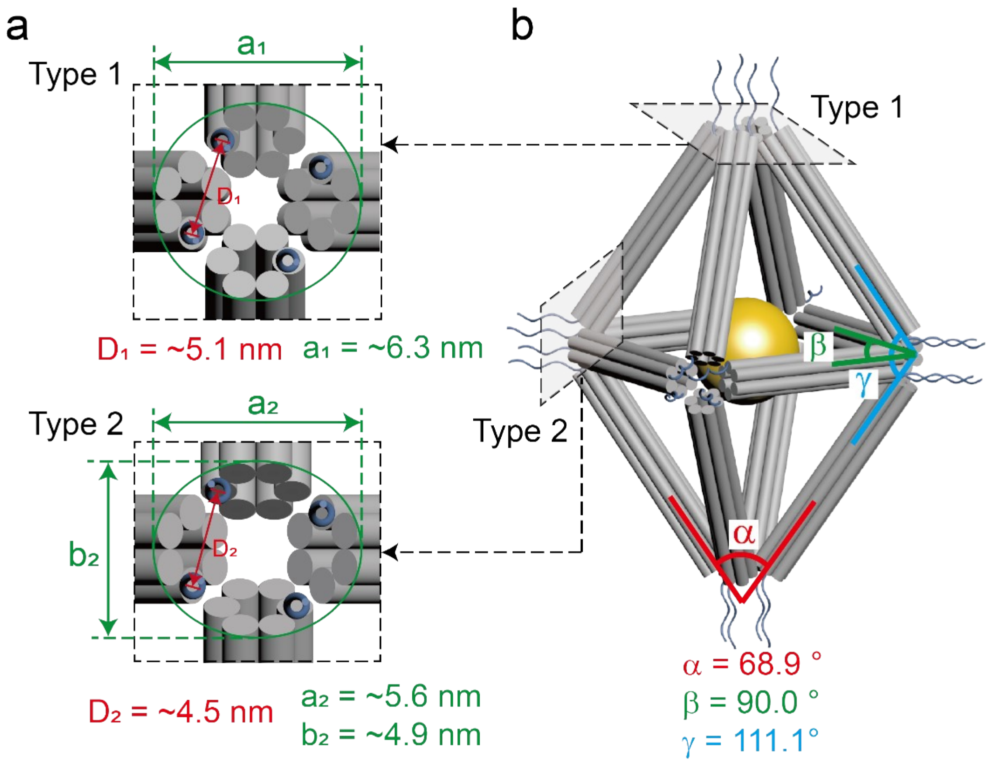

Figure S15. Schematic illustration of the geometry specifics of the vertices in the E-octa DOFs. (a) For each type of vertex, the distribution of the SEs, the estimated distance between adjacent SEs, and the estimated size of the vertices. (b) The estimated angles of the vertices existing in the E-octa DOFs.

V. DNA sequences

a. Staples of elongated octahedral DOFs

E-octa-staple-1	CTCGTTTACCAGACGACAACACTAAAGATT
E-octa-staple-2	AAAAGGGACATTCTGGTCACACGTTGCAAC
E-octa-staple-3	GCCACTACGAAGGCACGGGTAAAGCGAAAG
E-octa-staple-4	TTGGGGCGCGAGCTGATTAGCTATTCCATA
E-octa-staple-5	TTCAAATATATTTTAGAACGCGACCTCCGG
E-octa-staple-6	CAATATAATCCTGATTGATGATGATTTTAA
E-octa-staple-7	CAGACTGTAGCGCGTTAGTTTGCCCAGTAG
E-octa-staple-8	GTCCACTATTAAAGAACCAGTTTTGGTTCC
E-octa-staple-9	GAATAATAATTTTTTCCAACTAATAACGAT
E-octa-staple-10	GGCCGATTAAAGGGATCGGGAGCCCGCCGC
E-octa-staple-11	GCCTCTTCGCTATTACAGGGCGAGCACCGC
E-octa-staple-12	AAGCCAGAATGGAAAGAAATAAACAGAGCC
E-octa-staple-13	CCAGACGACGACAATAGGTAAAGCTCAACA
E-octa-staple-14	TACCCAAATCAACGTAAGAACCGACGGTCA
E-octa-staple-15	TTGCGCTCACTGCCCGACTCACACATGGTC
E-octa-staple-16	AATTACATTTAACAATTCAAGAAATTGCTT
E-octa-staple-17	GCCATCAAAAATAATTTTTAACCTAATCAG
E-octa-staple-18	AGTCAAATCACCATCAGAGAAAGTTTCAAC
E-octa-staple-19	AACAAAGTCAGAGGGTTTAACTGTTATCCC
E-octa-staple-20	TTATTTTGTCACAATCACACCACACGCAGT
E-octa-staple-21	ATCTGGTCAGTTGGCACAAACCCAGTATTA
E-octa-staple-22	TAAGTATAGCCCGGAAGTCGAGAAAACATG
E-octa-staple-23	AGCGAACCAGACCGGATTAATTCGTCAGAA
E-octa-staple-24	GACTTGCGGGAGGTTTTTTAGCTTACCGC
E-octa-staple-25	ACAGCATGCTCCATAGATTTGTATCATCCCCAGCGAAA

	CGAA
E-octa-staple-26	GAAATCGGCCCCCTACGGGGTCAGTGCCCTTTTGATCCAACG
E-octa-staple-27	AACGGGTCCTGAACAAGAAAAATAATATCTTATCATTCCAAG
E-octa-staple-28	AAAAGCCCTCAGGACGTTGGTGTAGATGGGGAACAGGCCTTC
E-octa-staple-29	ATTAAATCAGCTTTCATCAACATTAAATTTGTTAAAATTCGC
E-octa-staple-30	TACATTTAATAGTACATCCAATAAATCAAAGCTAACCAAAAA
E-octa-staple-31	GCCCAATTTTGCCATAACGAGCGTCTTTGCACCCATTAAATC
E-octa-staple-32	ATAGCGAAATTACGTAGGAATACCACATCAGTACAGTACCGT
E-octa-staple-33	GTTGGGATGAAAGAGGACAGATGAACGGAGTAGATCATTAGA
E-octa-staple-34	CTTTTTCAAAGAATACTCATCTTTGACCGCCTGATGAAATCC
E-octa-staple-35	AAGCCTGCGTGCCAGCTGCATTAATGAAAAGCATAAAGTGTA
E-octa-staple-36	TCAGTGATCATCAAGAACTGACCAACTTAGAAAAATCTACGT
E-octa-staple-37	TAACAGTACCCTGTAGCCTCAGAGCATATACAGGCGCATCAA
E-octa-staple-38	CTAATGCGAATATAAGAATCGCCATATTTACCGCACTCATCG
E-octa-staple-39	ATAGCTGTTGCCCCCGGGCAACAGCTGAATTGGGCGTCGGGA
E-octa-staple-40	GCCGCCATGTAGCGGGAAGGGAAGAAAGAGAGCTTTCTGAAT
E-octa-staple-41	GGAATTAAATGGAACTACCATATCAAAACGTCAGAGTAACAG
E-octa-staple-42	TCTGAATTCATCATTTATCATTTTGCGGTAATACATGAATGG
E-octa-staple-43	AGAGGCAATGAGGAAGGGTAGCAACGGCAGGTGTCAAATTCC
E-octa-staple-44	CGTTCTATAGGTAATTTTAGAACCCTCAAGGATGAACGGTAA
E-octa-staple-45	TTCTACTCGCAAATCAATTCTGCGAACGTGTTGTAATCGGTA
E-octa-staple-46	AGGAAAACCAGCAGACTGATAGCCCTAAACAATATAGATAGA

E-octa-staple-47	GAGCCGGTCGTAAGAAAGCGGCCAACGCTGATCGTGCTCAAG
E-octa-staple-48	AAACAGGAGATAACCCACAAGAATTGAGAGAGAATAACATAA
E-octa-staple-49	GTGCATCACAACCCGTCGGATTCTCCGTGGCGCATCGTAACC
E-octa-staple-50	CTAAAGTAGGCCGCACAATGACAACAACTGAATTTAAATCTC
E-octa-staple-51	AATCCAACAAAAGAAAGTAAGCAGATAGAATAGCACGCTAAT
E-octa-staple-52	TAACGTGAGAATCCGTGAGTGAATAACCACATAGCGATAGCT
E-octa-staple-53	GGATTATTGACCTGAATACGTGGCACAGAACATCGTACCGAA
E-octa-staple-54	GTACGCCCTTTCCTTACAGGGCGCGTACAGAGTCAATAGTGA
E-octa-staple-55	ATCATTTCGAAAGGAGCGGGAATAGCCCGCGAAAAAGCGTCA
E-octa-staple-56	TTAATTGATATAATGCTGTGGAAGCCCGATTAGAGAAGGCGA
E-octa-staple-57	ATCATAAACGAACTATGCGATTTTAAGAATGGTTTTGCTCAT
E-octa-staple-58	AAGCATCGAGGAAGATATCTTTAGGAGCGAAGTATAAACAAT
E-octa-staple-59	AAAGTATTCAAAAAGTCATAAATATTCAAAATGTTATCACCG
E-octa-staple-60	GCAAGGAACTAGCAGAGAGTCTGGAGCATTTTTGAATTCAAC
E-octa-staple-61	ATCAGAGGAAGCGCACGATTTTTTGTTTACGCAATAATAACG
E-octa-staple-62	CACCATTACCACCCGCCTCCCTCAGAGCTAATCAAGCATTTT
E-octa-staple-63	TTTGCTAAAAGCGTTTATTTTGTATCGGATACCATATGAAAT
E-octa-staple-64	TAATGTGGCTGATAAATTATGCTATTTTCCGCAATGCCTGAG
E-octa-staple-65	TAGATTAAATATATTGAGAAGTGTTTTTTGGACGAGCACGTA
E-octa-staple-66	CGAGGAAAACGTCAAAAATGAAAATAGCTACAGAGCTAAAGA
E-octa-staple-67	ATGTTAGTTATACACCGGAATCATAATTGACCGTGAATTCAT
E-octa-staple-68	CAAAAGGGAGGCTTGCCACCCTCAGAACAACCCATAACTACA

E-octa-staple-69	AAGATTAGTATTCTAAATCAGATATAGATATATTTTAAATAG
E-octa-staple-70	AACCGATTTTATCAGCTTGCTTTCGAGGCATCGCCCACGCAT
E-octa-staple-71	CAAAAAACGGAGTGTCTTTCCAGACGTTCTGAGGCTTGCAGG
E-octa-staple-72	TCGGTCGAGTAAATGAATTTTCTGTATGGTCACCACGATAGC
E-octa-staple-73	CAGACCAAAATTAAGTAGCCACCAGAACGGTTGACTTAGTAC
E-octa-staple-74	CAGAGGCAAAGAACGGGTTTAGATAAGTATACCAGAAACCTA
E-octa-staple-75	GTTTCAGAAGGCTCCAAAAGGAGCCTTTAACAACTTTCAACA
E-octa-staple-76	AACCTGTGGGTGCCTGTGAAATTGTTATCAGCAAGCGGTCCA
E-octa-staple-77	CAGAAGGAATAAGAGCAAGAAACAATGACCGAACAAAGTTAC
E-octa-staple-78	TTTACAGTTAAAACACACTAAGCCCAATAAGAGGAGCTTTAC
E-octa-staple-79	GTAGGGCGCAAGCCATCGGCTGTCTTTCCCCATCCTGTTCAG
E-octa-staple-80	AAGTTTGTACATCGATTTTCAGGTTTAATTATTTGTTATACT
E-octa-staple-81	ACTTGCCATAATCAACAGTACATAAATCAGATTTCTATTCAC
E-octa-staple-82	TAATATTGTCTAAAGTTATGAGCGAGTATGATGAAAGCAACC
E-octa-staple-83	ATGGTTTACATATAAGAAAATACATACAAACTGTTTAGTATC
E-octa-staple-84	CGGTCATTAATCAGGCAAGGCCGGAAACGGAACCGCTCAGAT
E-octa-staple-85	ACCCTTCTTACATTTGGAAATACCTACAATAAAAACCATTAC
E-octa-staple-86	CAGTTCAGAGAAGGATTAGTTTCGTCACTCAACTAATAACGC
E-octa-staple-87	GGTCAGGAAAGACTATCAAAAAGATTAACACCTGCAGGTCGA
E-octa-staple-88	TGAGCAAAATGGAAGTGAGGCCACCGAGTTAGTAACTATCGG
E-octa-staple-89	AGAGTTGCCGCTCACAATTCCACACAACTTTTGACCTGAAAT
E-octa-staple-90	AGCACCGAGCCCCCTTGCCATCTTTTCACGCCACCCCACCCT

E-octa-staple-91	CTTTTTTAAGAAGACAAAATCGCGCAGAACTCAAATA ACATC
E-octa-staple-92	AGGAATTACCTTGCAGTGCCACGCTGAGACTTTACTAG ACGT
E-octa-staple-93	CCAGTCAGAGTAGTAAATTGGGCTTGAGACTGGCTCAT TATA
E-octa-staple-94	GCAAAGCGGATCCCACGACGGCCAGTGCGGGTAACTC CAACA
E-octa-staple-95	AACACTGCAGAACCTTGCAAAAGAAGTTTAGATACAT GCAAA
E-octa-staple-96	CCACCCTAGGATTAGCGGGGTTTTGCTCGAGGTTTAGG GGGT
E-octa-staple-97	GCTGAGATATGGTTGCTTTAGTAGAAGAGGCGAATAA TTACC
E-octa-staple-98	AGTTTGAAAGCAAATATTTAAATTGTAAAGCCAGCAA ATCTA
E-octa-staple-99	GCTTAATAAAATCATAGAATCCTTGAAATTGCTTCAGG AACG
E-octa-staple-100	TCAAAGGGAGATAGCCCTTATAAATCAAAGGCCCGTA TAAAC
E-octa-staple-101	TTCTGGTATGCAACAGCTTAATTGCTGACTCCTTTGGC GAAA
E-octa-staple-102	AATAAGAAGAACGCGCCTGTTTATCAACATTTTCGAGC CAGT
E-octa-staple-103	CTTAGGTGAGCCATGACGGAAATTATTCGCGACATCAT CTTC
E-octa-staple-104	AAATACCACTAGAAAAAGCTGCTGATGCAATTTAACC AAAGA
E-octa-staple-105	TGAATACGGTAATACAATACTTCTTTGATAAAAGAGAA TTAC
E-octa-staple-106	TGACCTAAAATCCATATAACTATATGTATATTATCACC GTCA
E-octa-staple-107	CTGTAGCTTTTGTTCAGGAAGATTGTATGGGGACGACG ACAG
E-octa-staple-108	GGGGGATCAGGCTGACCAGGCAAAGCGCGAAGCTCAA CATGT
E-octa-staple-109	ACACCGCCTCGTATCATTTGAGGATTTAACTAACAAGT TGAA
E-octa-staple-110	CTGGCCCGCGGGGAGAGGCGGTTTGCGTTTGCCCTTCA CCGC
E-octa-staple-111	TACTCAGAGTACCACTGAGACTCCTCAAGAAAACGAG AATGA
E-octa-staple-112	AATAGTATTGAATCCCCCTCAAATGCTTTTGCCAGAGT ACCG

E-octa-staple-113	CAAAAGGATTAAAGGTGAAAAGGTGGCAACCAGCGTGGTTTG
E-octa-staple-114	TTACCGTTTGGCCTCAGGAGGTTGAGGCAAGCGCTAGGGCGC
E-octa-staple-115	TACATGGTTGAGTAACAGTGTCAGACGATCCAGTAACCGTCT
E-octa-staple-116	TTAAGTTCAAGCTTGCATGTTCGCCATTGTGCTGCAGTACCT
E-octa-staple-117	TTATCCGGTATGCCGGAGAGGGTAGCTAAACAAGAGAATCGC
E-octa-staple-118	CTGACCTATAAGGCTTGCCCTGACGAGAGGCGCATAGGCTGG
E-octa-staple-119	AACCAAGTAACAACGCCAACATGTAATTAACAAAGAAGGAGC
E-octa-staple-120	CATCAGTTAGCATTGCAAGCCCAATAGGCGCCACCAACCAAA
E-octa-staple-121	GAATACCATAAGAAATTAGACGGGAGAAAATTGAGATAGCTATCTTACCGAAGC
E-octa-staple-122	GCGACCTCGGAACGAGTTTCCATTAAACCAACCTAATTATACCAAGCGCGAAAC
E-octa-staple-123	TATCGGCCCAAAAAAAATCAGCTCATTTCGCGTCTAACGGCGGATTGACCGTAA
E-octa-staple-124	CATTATGTGATTCCGGTCAATAACCTGTAAAGGTGAAGGCAAAGAATTAGCAAA
E-octa-staple-125	AGAACAATTAATTGAAGTACCGACAAAAAACAACATAATTTACGAGCATGTAGA
E-octa-staple-126	ACGCCTGTGAGATTAGGCATAGTAAGAGCGATAAACTCAGAGCCACCACCCTCA
E-octa-staple-127	CGCTGGTTTTCCTGTAATGAGTGAGCTACTTTCCAGCCAGGGTGGTTTTTCTTT
E-octa-staple-128	CGAACCAACGCTCAGGCAGATTCACCAGCCAACAGTTTTGAATGGCTATTAGTC
E-octa-staple-129	TAATAAAGGGAACCGAGTAATCTTGACAACAAAGCAATTTCAACTTTAATCATT
E-octa-staple-130	CCTTGCTCAAGTTATGATGAAACAAACATTCATTTGTCTGTCCATCACGCAAAT
E-octa-staple-131	GAGTTAATTTGTCGAGAATAGAAAGGAAACGTTGACTTAAACAGCTTGATACCG
E-octa-staple-132	TCGACAACTGCAACTGAACCTCAAATATAATCAACACTAATAGATTAGAGCCGT
E-octa-staple-133	CAGAGCCACCATTATAGCGACAGAATCATTCATCGAATCACCGGAACCAGAGCC
E-octa-staple-134	TACCTTTAGTAACAATTCCTGATTATCAGTTTGGACACGTAAAACAGAAATAAA

E-octa-staple-135	ATTTATCGCGCCGCCGTTAGAATCAGAGTTTAGACTGTAAATCGTCGCTATTAA
E-octa-staple-136	CCATAAATAAGAGGGGCGGATAAGTGCCTAGGTGTTAGACTGGATAGCGTCCAA

b. Sticky ends of elongated octahedral DOFs

E-octa-SE-A-1	AAAGTACAACGGGTTACTTAGCCGGACTCAGCAATACGTAATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-2	ATAGTTGCGCCGTTTTGCGGGATCGTGTTAGCGAGGAATTGCTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-3	GTGAATTACCTTAACGGAACAACATTGGCGCAGGATATTCATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-4	TTTTCAGGGATACCACAGACAGCCCTCAGGTAGATCATAACCTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-5	AGGTCATTGCCTTGTCAATCATATGTGCCTTTAGCCGGAGACTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-6	TGGGATAGGTCAAGATCGCACTCCAGCGGTTGAAATAGGAACTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-7	ATTAAGCAATAAAATACTTTTGCGGGAGTTTCATATTTTCATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-8	CGGATGGCTTAGTAAAGTACGGTGTCCTTTCCGTCGGTGCGGTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-9	TCACCAGTGAGAAGCAGGCGAAAATCTCGTAATTTAATTGCGTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-10	TAATAAGTTTAGCCTATTTCGGAACTTGATGGGGAACAAGATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-11	CGACGTTGTAAACGGGTACCGAGCTCTATTATAGAGCTTCAATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-12	TACTGCGGAATCTCAGGTCTTTACCCTATTCTGGGGTTGATATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-13	TTAATTTTCCCTTAGGTCTGAGAGACACCACACTAAACAGGATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-14	ACCACCGGAACCTCAGAGCCGCCACCAAAATCACTTTAGCGTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-15	AAGGTAAATATTTTGGGAATTAGAGCTTTTTAAGAAAACTTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-16	CGTGGCGAGAAAGTCACGCTGCGCGTCCACCACTCCTCATTATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-17	CCTTTTTAAGAAACTGGCATGATTAAATATTATAACACCCTGTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-18	TCTTACCAACGCGTTACAAAATAAACGGAATCAGAACCTCCCTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-19	AACCAATCAATAGTTTTATTTCATGCCAACGTAATTCTGTTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT

E-octa-SE-A-20	TAAGAATAAACAAATTCTTACCAGTACCTTATTGGAAT AAGTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-21	CAATAGATAATATAAATCCTTTGCCCGGCGGTCTCAAT CAATTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-22	TTTAATGCGCGAAAGATAAAACAGAGCCAGCCAACCA GTAATTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-23	TAACCGTTGTAGTCCAGAACAATATTTCGCCTGAACAA AATTTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-A-24	GAAATTGCGTAGGGAGAAACAATAACGTTATTAGCAA TTCATTTTTTTTTTTTTTTTTTTTTTTCATCAAGT
E-octa-SE-B-1	AAAGTACAACGGGTTACTTAGCCGGACTCAGCAATAC GTAATTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-2	ATAGTTGCGCCGTTTTGCGGGATCGTGTTAGCGAGGAA TTGCTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-3	GTGAATTACCTTAACGGAACAACATTGGCGCAGGATA TTCATTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-4	TTTTCAGGGATACCACAGACAGCCCTCAGGTAGATCAT AACCTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-5	AGGTCATTGCCTTGTCAATCATATGTGCCTTTAGCCGG AGACTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-6	TGGGATAGGTCAAGATCGCACTCCAGCGGTTGAAATA GGAACTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-7	ATTAAGCAATAAAATACTTTTGCGGGAGTTTCATATTT TCATTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-8	CGGATGGCTTAGTAAAGTACGGTGTCCTTTCCGTCGGT GCGGTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-9	TCACCAGTGAGAAGCAGGCGAAAATCTCGTAATTTAA TTGCGTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-10	TAATAAGTTTTAGCCTATTTCGGAACTTGATGGGGAAC AAGATTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-11	CGACGTTGTAAACGGGTACCGAGCTCTATTATAGAGCT TCAATTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-12	TACTGCGGAATCTCAGGTCTTTACCCTATTCTGGGGTT GATATTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-13	TTAATTTTCCCTTAGGTCTGAGAGACACCACACTAAAC AGGATTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-14	ACCACCGGAACCTCAGAGCCGCCACCAAAATCACTTT AGCGTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-15	AAGGTAAATATTTTGGGAATTAGAGCTTTTTAAGAAA ACTTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-16	CGTGGCGAGAAAGTCACGCTGCGCGTCCACCACTCCT CATTATTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-17	CCTTTTTAAGAAACTGGCATGATTAAATATTATAACAC CCTGTTTTTTTTTTTTTTTTTTTTTTACTTGATG

E-octa-SE-B-18	TCTTACCAACGCGTTACAAAATAAACGGAATCAGAACCTCCCTTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-19	AACCAATCAATAGTTTTATTTTCATGCCAACGTAATTCTGTTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-20	TAAGAATAAACAAATTCTTACCAGTACCTTATTGGAATAAGTTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-21	CAATAGATAATATAAATCCTTTGCCCGGCGGTCTCAATCAATTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-22	TTTAATGCGCGAAAGATAAAACAGAGCCAGCCAACCAGTAATTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-23	TAACCGTTGTAGTCCAGAACAATATTTCGCCTGAACAAAATTTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG
E-octa-SE-B-24	GAAATTGCGTAGGGAGAAACAATAACGTTATTAGCAATTCATTTTTTTTTTTTTTTTTTTTTTTTTACTTGATG

c. Inner strands of elongated octahedral DOFs

E-octa-inner-1	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTAGCCTAAAGCAAGCAAGAACGCGAGGCGTGAAGCCGCTACAATTTTATCCTGAA
E-octa-inner-2	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTTCGTAAATAAAAATAGATTCAAAAGGGTATATGATGAGATCTACAAAGGCTATC
E-octa-inner-3	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTATATGCGCAAACGTAAAGAAACGCAAAGAATAGAATGATAAATAAGGCGTTAAA
E-octa-inner-4	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTCCGACTTTGGGTTAATCGCAAGACAAAGTTAATTTCAACCGATTGAGGGAGGG
E-octa-inner-5	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTAGTTAATGCAAAATGGTTGAGTGTTGTTCGTGGACTGATACAGGAGTGTACTGG
E-octa-inner-6	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTTGGCAAGGCATTGATGATATTCACAAACCGCAGTCGACGGGGAAAGCCGGCGAA
E-octa-inner-7	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTCTCTAGAGGATTGCTCAAATATCGCGTTAGCAAACGCCAGGGTTTTCCCAGTCA
E-octa-inner-8	ATCCATCACTTCATACTCTACGTTGTTGTTGTTGTTGTTTTTAAATGCCGGAACGCAACTGTTGGGAGCCAGCTTGATAAGAGGTCATTTTTG

VI. Supplementary References

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