

Supporting Information

Chiral Magneto-Optical Properties of Supra-Assembled Fe₃O₄ Nanoparticles

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Table S1. Obtained fitting parameters and peak assignment for the SP1.

Peak position (eV)	FWHM (eV)	Peak area (%)	Assignment
709.9	1.903	25.89	Fe ²⁺ (oct)
711.17	1.897	19.17	Fe ³⁺ (oct)
712.8	2.88	16.12	Fe ³⁺ (tet)
723.39	2.74	14.88	Fe ²⁺ (oct)
724.93	2.69	9.61	Fe ³⁺ (oct)
726.84	3.63	4.94	Fe ³⁺ (tet)
718.72	4.27	6.50	2p _{3/2} sat
732.82	3.09	2.84	2p _{1/2} sat

Table S2. Obtained fitting parameters and peak assignment for the SP2.

Peak position (eV)	FWHM (eV)	Peak area (%)	Assignment
709.98	1.86	22.33	Fe ²⁺ (oct)
711.34	1.99	17.96	Fe ³⁺ (oct)
713.17	3.02	14.68	Fe ³⁺ (tet)
723.41	2.97	13.32	Fe ²⁺ (oct)
724.92	2.98	9.57	Fe ³⁺ (oct)
727.01	4.2	7.01	Fe ³⁺ (tet)
718.54	5.0	11.23	2p _{3/2} sat
732.66	3.76	3.85	2p _{1/2} sat

Table S3. List of peak positions and transition information for the deconvolution of the CD (Figures 3c and d) and UV–Vis absorption spectra (Figures 3e and f).

Figure 3(c)	Peak1	Peak2	Peak3	Peak4	Peak5	Peak6	Peak7
Charge Transfer	LMCT			ISCT			IVCT
Dominant Transition	$O(2p) \downarrow \rightarrow B(t_{2g}) \downarrow$			$B(e_g) \uparrow \rightarrow A(e_g;t_{2g}) \uparrow$			$B(t_{2g}) \downarrow \rightarrow B(e_g) \downarrow$
Xc	222.5	287.0	345.0	410.0	462.1	519.9	657.0
W	51.1	65.9	41.7	50.0	70.0	70.0	239.4
A	-477.9	-1156.1	-197.1	269.9	2100.0	600.0	-5100.0
A%	4.8	11.7	2.0	2.7	21.2	6.1	51.5

Figure 3(e)	Peak1	Peak2	Peak3	Peak4	Peak5	Peak6	Peak7
Xc	222.5	287.0	345.0	410.0	462.1	519.9	657.0
W	66.0	112.1	104.9	105.8	195.4	190.6	312.0
A	41.0	96.7	31.1	38.5	121.6	48.5	137.8
A%	8.0	18.8	6.0	7.5	23.6	9.4	26.7

Figure 3(d)	Peak1	Peak2	Peak3	Peak4	Peak5	Peak6	Peak7
Xc	230.1	298.4	360.0	423.7	461.9	520.0	726.9
W	56.2	73.5	60.8	54.2	65.7	67.8	250.0
A	-375.0	-898.9	-378.2	82.5	769.5	491.2	-9117.3
A%	3.1	7.4	3.1	0.7	6.4	4.1	75.3

Figure 3(f)	Peak1	Peak2	Peak3	Peak4	Peak5	Peak6	Peak7
Xc	230.1	298.4	360.0	423.7	461.9	520.0	726.9
W	80.3	186.6	199.9	73.0	100.2	94.0	483.5
A	35.0	143.3	36.1	4.9	250.1	258.3	488.7
A%	2.9	11.8	3.0	0.4	20.6	21.2	40.2

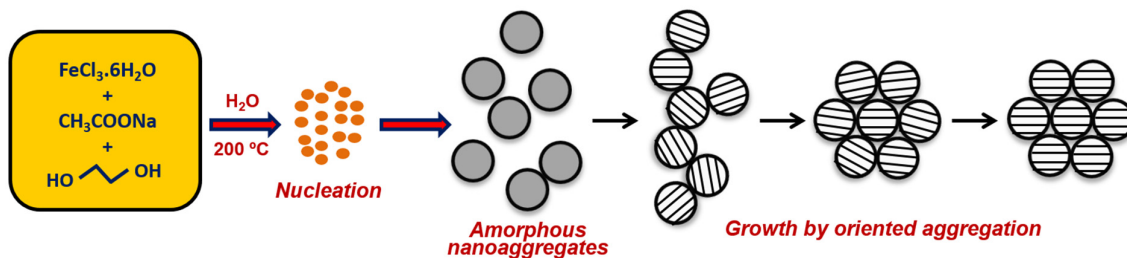


Figure S1. Schematic representation highlighting the formation of SPs by oriented aggregation, where individual constituent nanocrystals assemble, rotate and align till crystallographic alignment corresponding to single crystal-like structure is attained.

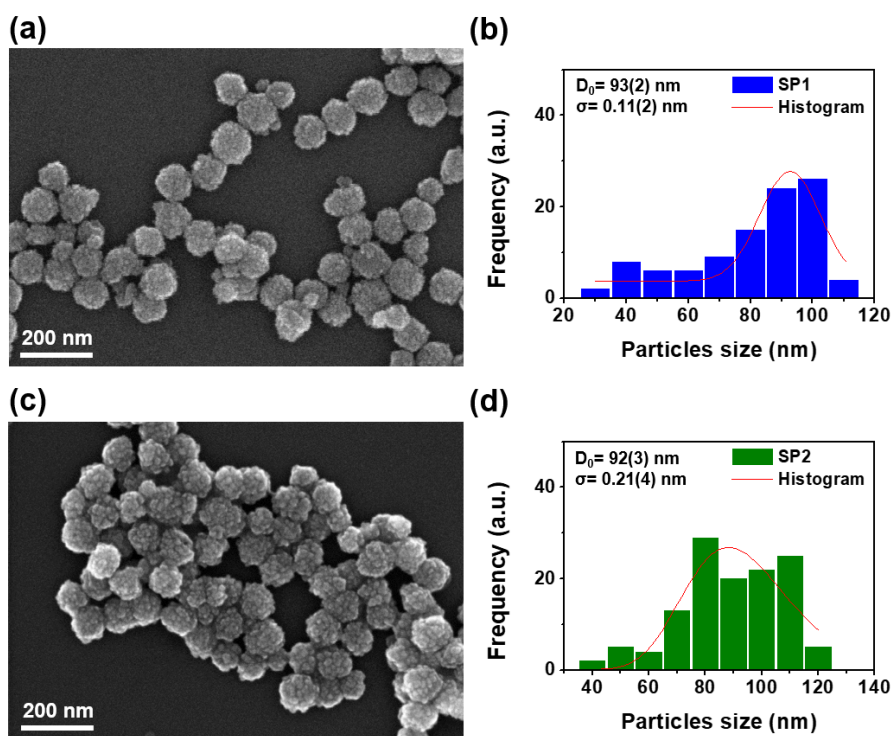


Figure S2. Electron microscope analysis of Fe_3O_4 supra-assembled particles with 2 h and 16 h (SP1 and SP2): (a and c) SEM and (b and d) histogram distribution of particle size.

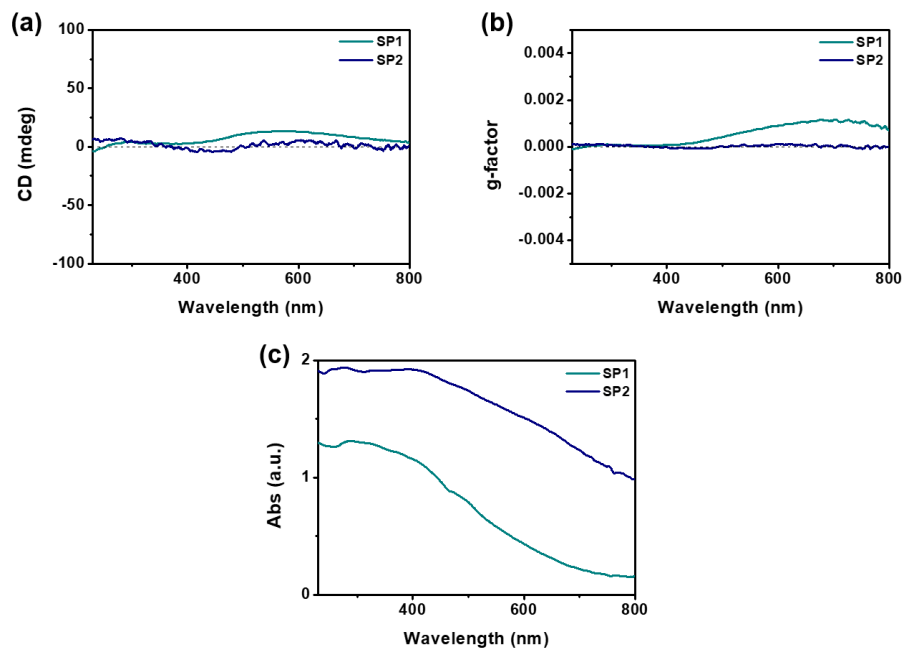


Figure S3. (a) CD, (b) g-factor, and (c) UV-Vis absorption spectra of the SP1 and SP2.

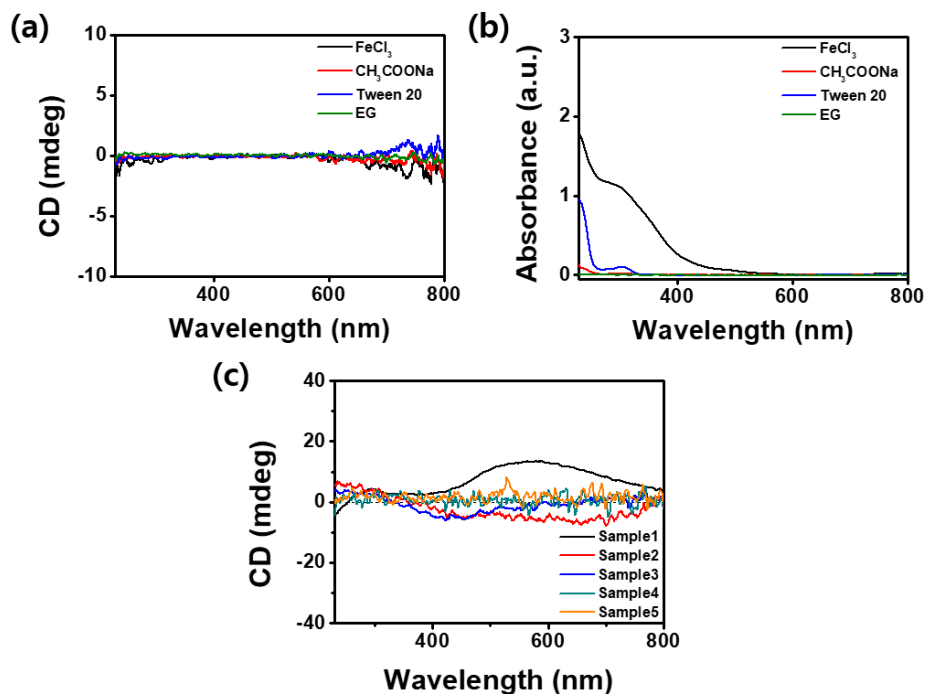


Figure S4. (a) CD spectra and (b) UV-visible absorbance spectra of reactant chemicals utilized for the synthesis of SP samples. The reactants do not show CD signals, indicating no chiral impurity. (c) CD spectra of the SP1 sample from Figure S3 and new batch SP samples. CD spectra of Sample 1-3 were obtained with standard accessory with absence of magnetic field. Sample 4 and 5 were agitated with magnetic stirring accessory at 100 rpm and 1000 rpm, respectively. By vigorous agitations, CD signals disappeared.

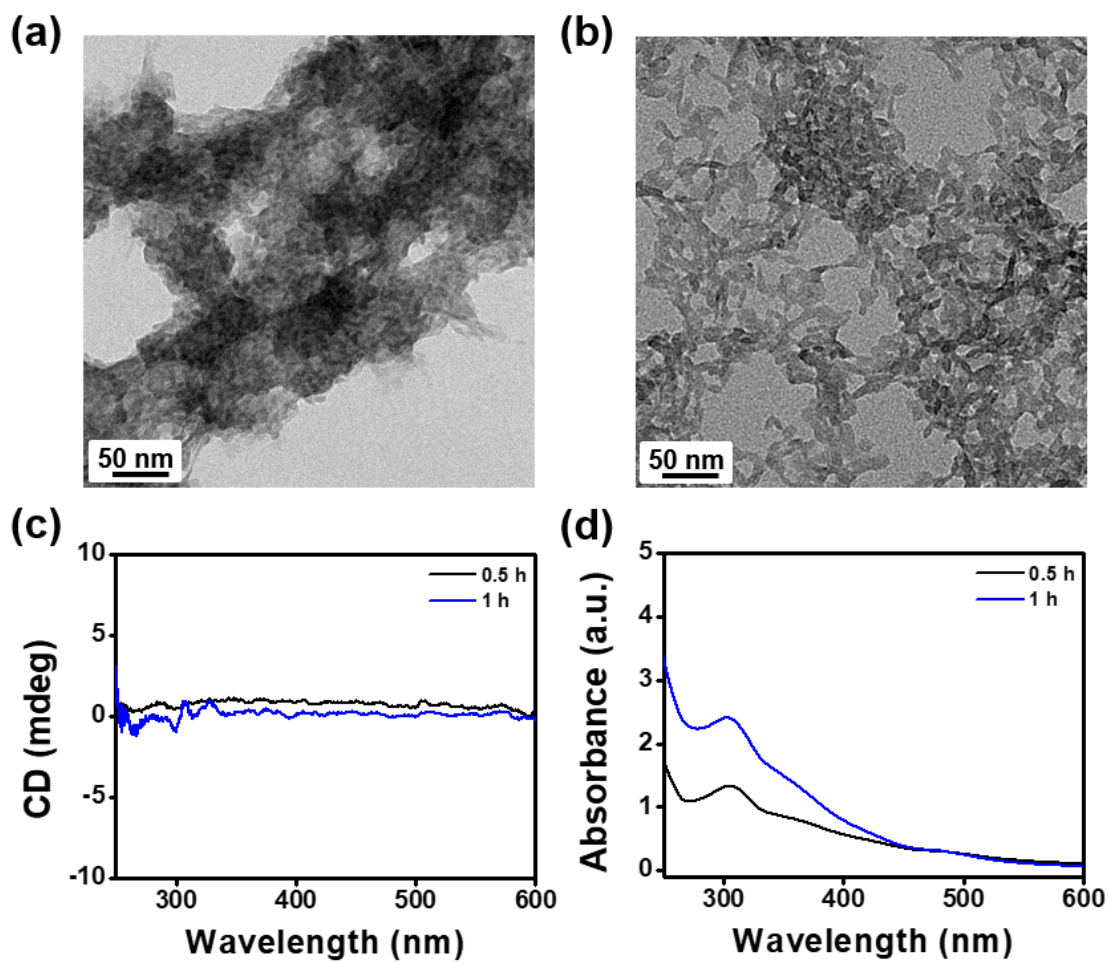


Figure S5. TEM analysis of the Fe₃O₄ supra-assembled particles with (a) 0.5h and (b) 1h. (c) CD spectrum and (d) UV-Vis absorption data.

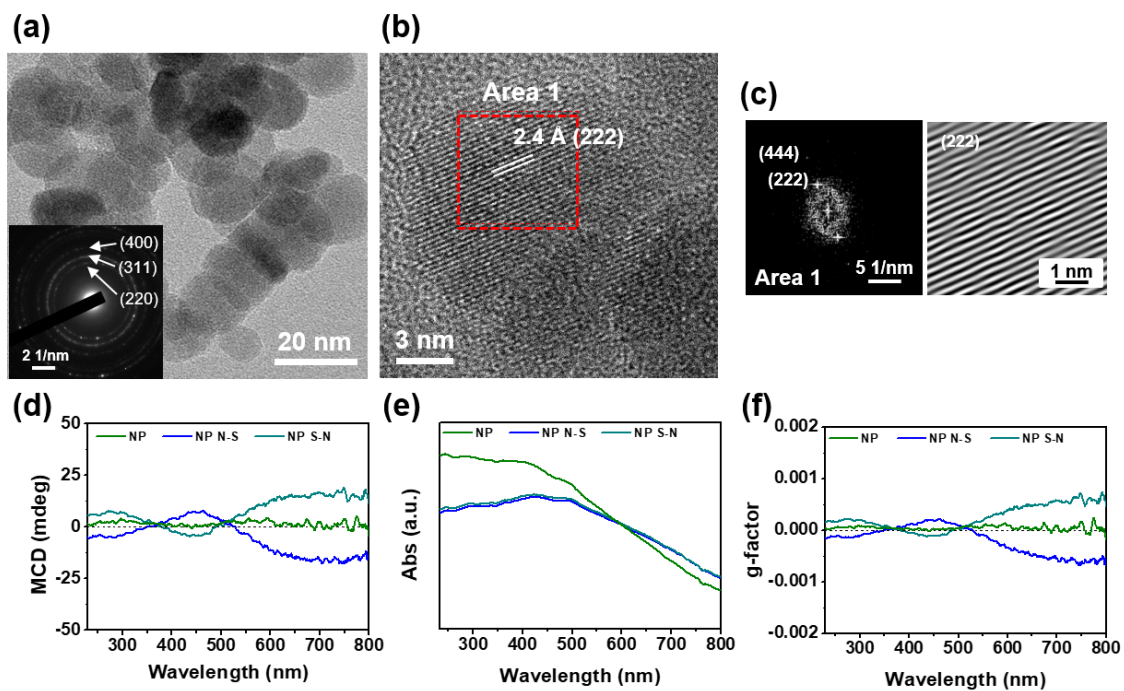


Figure S6. (a) TEM analysis of the Fe₃O₄ nanoparticles (NPs). The inset shows SAED pattern of polycrystalline characteristic. (b) A magnified high-resolution image for the (c) FFT analysis. The inverse patterns of (222) planes from Area 1 are shown in the right panel of (c). Chiral magneto-optical properties of the NP with 1.5 mT: (d) MCD, (e) UV-Vis absorption, and (f) g-factor from MCD measurements.