Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Synthesis of Bimetallic Aluminum-Iron Oxide Nanorice, Nanocubes and Nanospheres

Abdul Hoque[†], Artur Huseinov[†], Chaminda P. Nawarathne[†], and Noe T. Alvarez [†]*

[†]Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221, United States

*E-mail: alvarene@ucmail.uc.edu

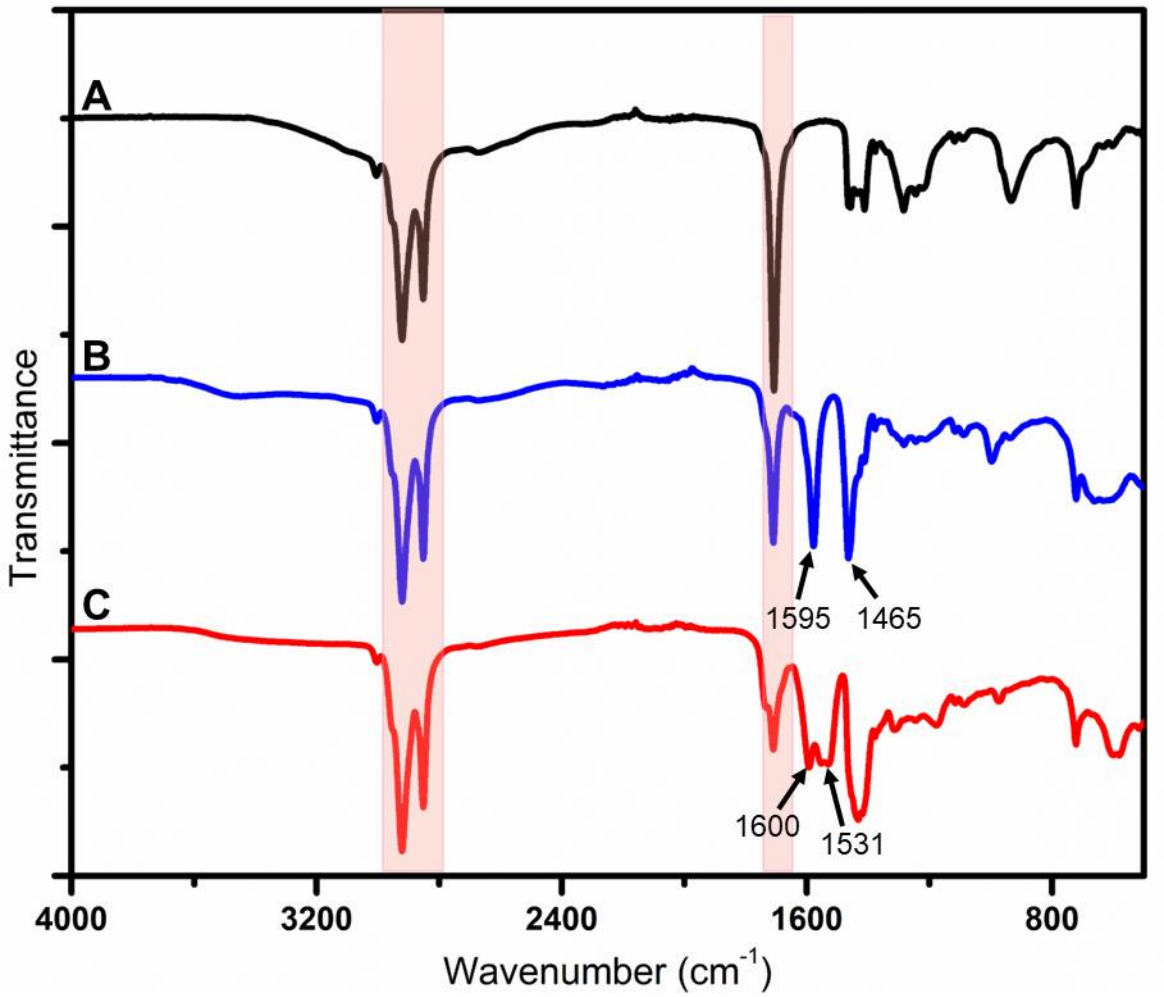

Figure S1: FTIR spectra of (A) pure oleic acid, (B) aluminum oleate and (C) iron oleate.

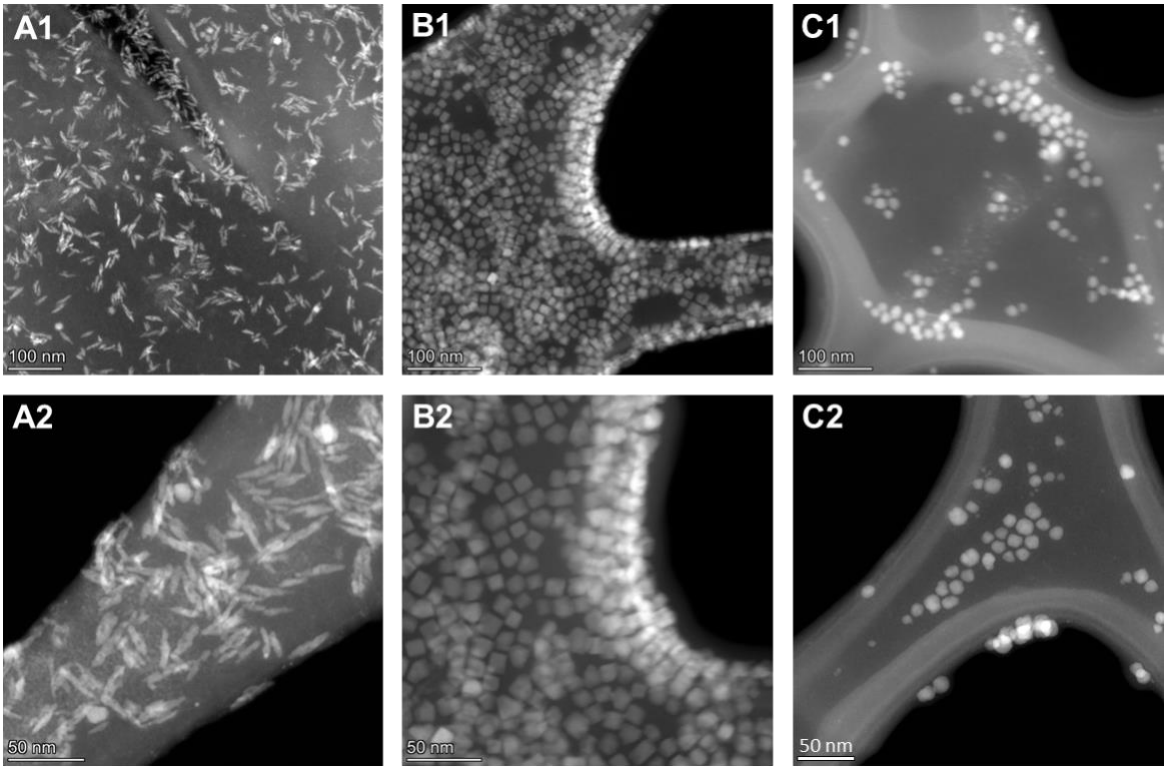

Figure S2: HAADF-STEM images of bimetallic AlO_x-Fe_2O_3 nanoparticles with different shapes. Low magnification HAADF images of bimetallic: (A1) nanorice, (B1) nanocubes, and (C1) nanospheres. High magnification images of bimetallic AlO_x-Fe_2O_3: (A2) nanorice, (B2) nanocubes, and (C2) nanospheres.

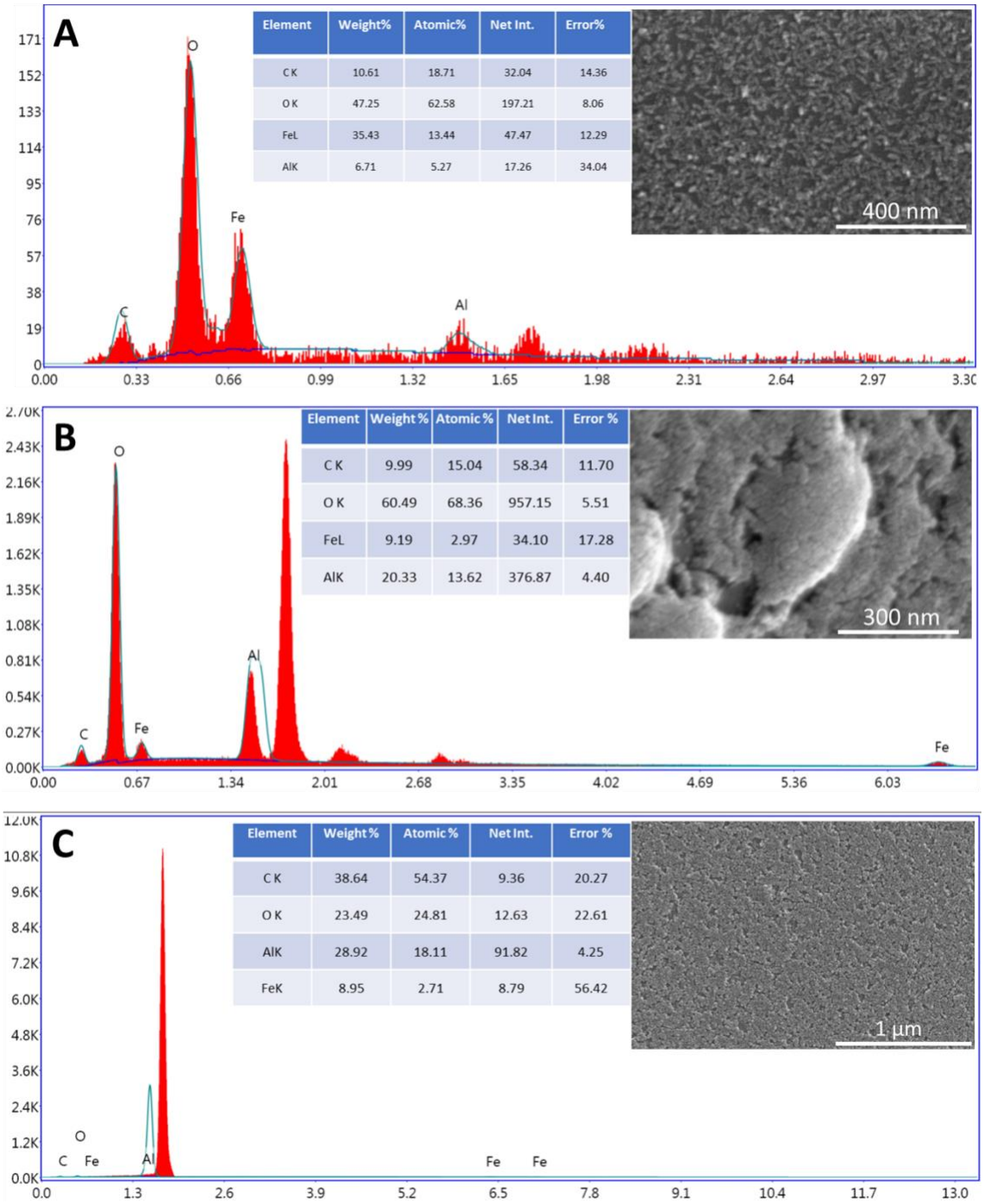

Figure S3: EDX analysis of as-synthesized bimetallic AlO_x-Fe_2O_3 nanoparticles: (A) nanorice, (B) nanocubes, and (C) nanospheres.

Table S1: Atomic percent of different elements present in three different shapes of bimetallic AlO_x-Fe_2O_3 nanoparticles synthesized from three different weight ratio of precursors mixture by XPS survey analysis.

Precursor ratio Fe-oleate: Al-oleate	**Atomic % of Fe**	**Atomic % of Al**	**Atomic % of O**	**Atomic % of C**
(0.5 g + 1.5 g) 1:3	**4.95**	**12.18**	**36.03**	**43.93**
(1.0 g + 5.0 g) 1:5	**4.4**	**23.48**	**53.03**	**19.08**
(1.2 g + 12 g) 1:10	**3.27**	**26.27**	**53.01**	**11.73**

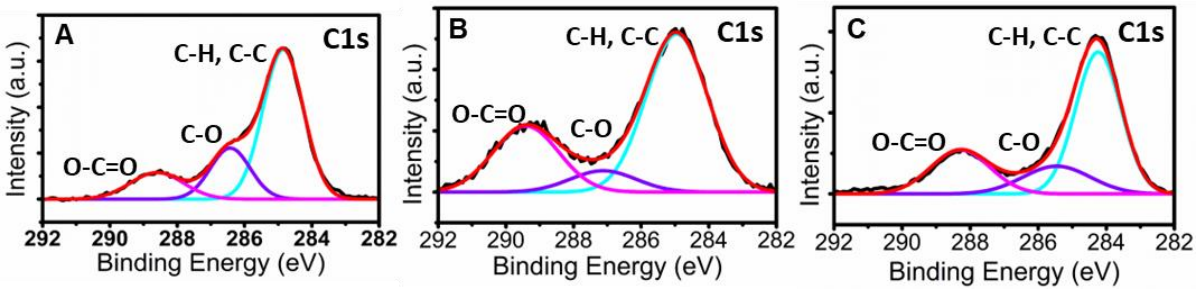

Figure S4: XPS core level spectra of C1s peaks from three different shapes bimetallic AlO_x-Fe_2O_3 nanoparticles. (A) nanorice, (B) nanocubes, and (C) nanospheres.

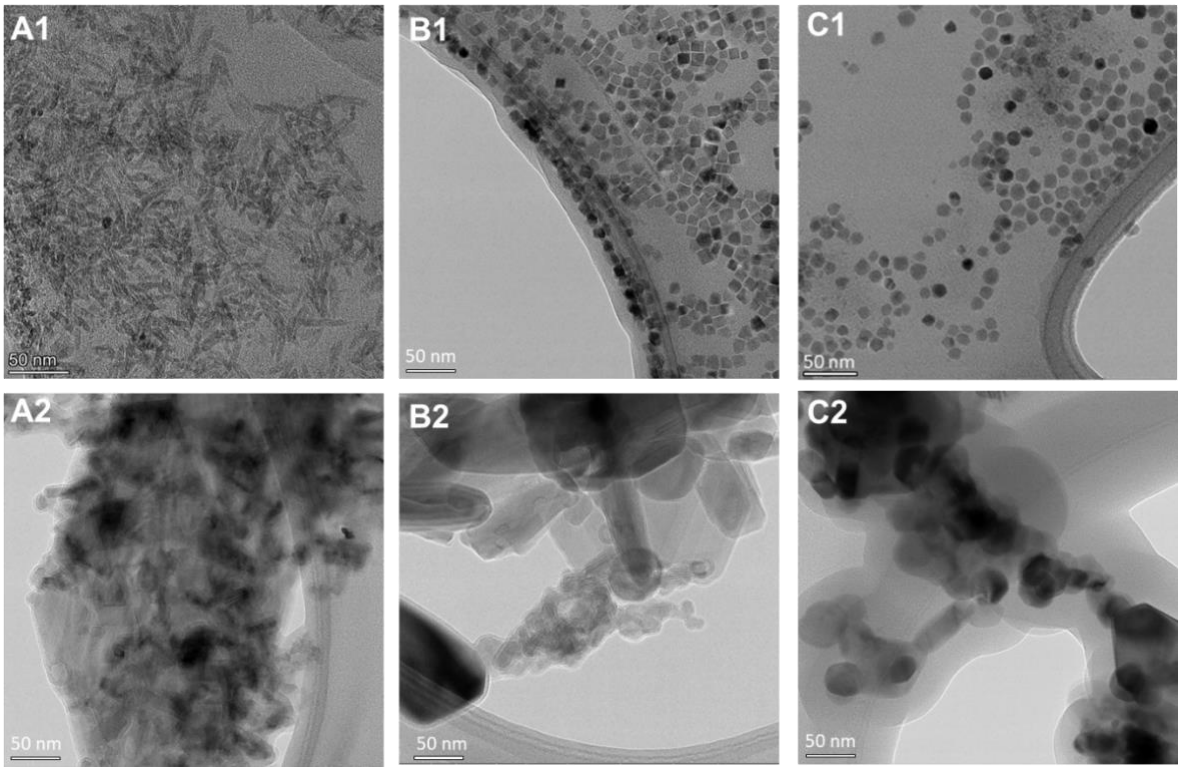

Figure S5: TEM images of bimetallic AlO_x-Fe_2O_3 nanoparticles before and after annealing at 1100 °C for 4 h. (A1, A2) nanorice, (B1, B2) nanocubes, and (C1, C2) nanospheres.

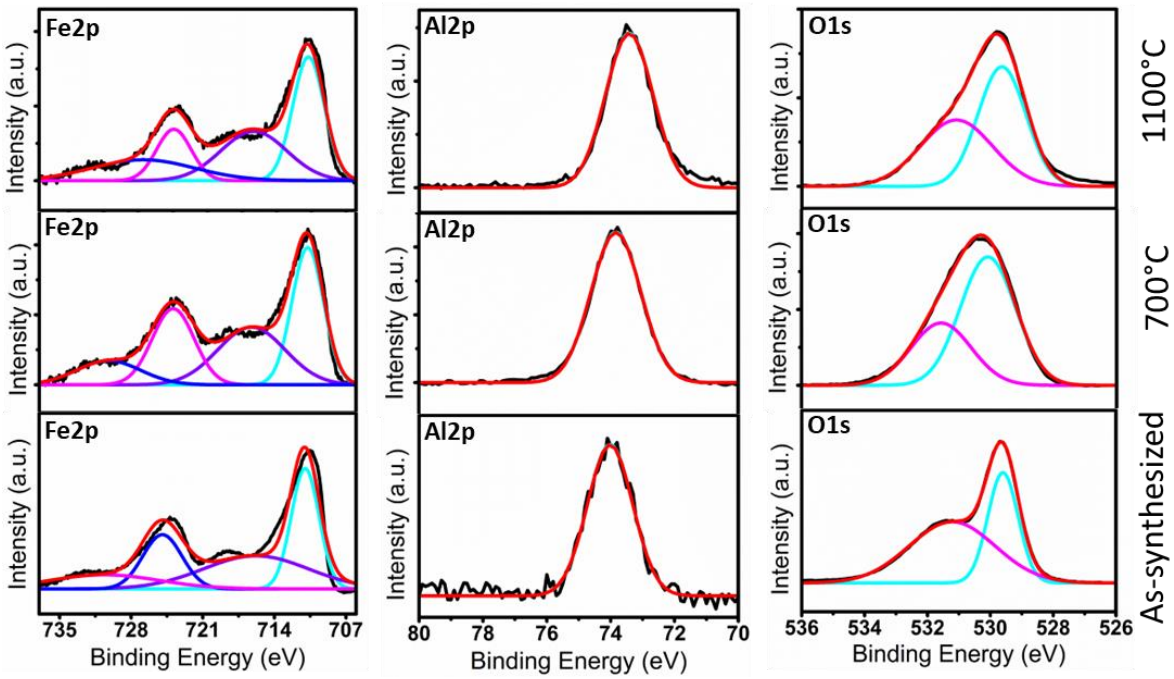

Figure S6: XPS core level spectra (Fe2p, Al2p, O1s) of bimetallic AlO_x-Fe_2O_3 nanorice particles, for the as-synthesized, annealing at 700 °C, and 1100 °C.

Table S2: XRD lattice parameters of α-Fe_2O_3 nanoparticles as specified in ICDD:00-001-1053.

#	Peak position (2Θ)	Interplanar distance d (A°)	Intensity	Miller Indices (hkl)
1	24.16	3.68	18	012
2	33.28	2.69	100	104
3	35.74	2.51	75	110
4	40.99	2.2	18	113
5	49.5	1.84	63	024
6	54.23	1.69	63	116
7	57.56	1.6	13	122
8	62.26	1.49	50	214
9	64.18	1.45	50	300
10	69.58	1.35	3	208
11	72.03	1.31	18	1010
12	75.37	1.26	13	217
13	77.55	1.23	3	306

Table S3: XRD lattice parameters of as-synthesized AlO_x-Fe_2O_3 nanorice

#	Peak position (2Θ)	Interplanar distance d (A°)	Intensity	Miller Indices (hkl)
1	24.05	3.70	25.89	012 (α-Fe_2O_3)
2	33.1	2.70	100	104 (α-Fe_2O_3)
3	35.57	2.52	85.82	110 (α-Fe_2O_3)
4	40.73	2.21	32.17	113 (α-Fe_2O_3)
5	49.5	1.84	53.58	024 (α-Fe_2O_3)
6	54.06	1.70	55.02	116 (α-Fe_2O_3)
7	62.31	1.49	41.18	214 (α-Fe_2O_3)
8	63.94	1.45	48.20	300 (α-Fe_2O_3)
9	71.91	1.31	24.99	1010 (α-Fe_2O_3)

Table S4: XRD lattice parameters of as-synthesized AlO_x-Fe_2O_3 nanorice annealed at 700 °C

#	Peak position (2Θ)	Inter planar distance d (Å)	Intensity	Miller indices (hkl)
1	24.14	3.68	18.75	012 (α-Fe_2O_3)
2	33.19	2.69	100	104 (α-Fe_2O_3)
3	35.68	2.51	90.51	110 (α-Fe_2O_3)
4	37.61	2.39	37.64	311 (γ-Al_2O_3)
5	40.9	2.20	37.32	113 (α-Fe_2O_3)
6	45.85	1.98	34.94	400 (γ-Al_2O_3)
7	49.48	1.84	29.86	024 (α-Fe_2O_3)
8	54.17	1.69	41.17	116 (α-Fe_2O_3)
9	62.59	1.48	35.51	214 (α-Fe_2O_3)
10	64.18	1.45	36.63	300 (α-Fe_2O_3)
11	66.78	1.40	39.96	440 (γ-Al_2O_3)

Table S5: XRD lattice parameters of as-synthesized AlO_x-Fe_2O_3 nanorice annealed at 1100 °C

#	Peak position (2Θ)	Inter planar distance d (Å)	Intensity	Miller indices (hkl)
1	24.23	3.67	28.91	012 (α-Fe_2O_3)
2	25.36	3.51	46.68	012 (α-Al_2O_3)
3	33.24	2.69	100	104 (α-Fe_2O_3)
4	34.95	2.56	96.93	104 (α-Al_2O_3)
5	35.66	2.52	85.26	110 (α-Fe_2O_3)
6	37.6	2.39	52.06	110 (α-Al_2O_3)
7	40.99	2.20	28.43	113 (α-Fe_2O_3)
8	43.15	2.09	89.83	113 (α-Al_2O_3)
9	49.67	1.83	41.28	024 (α-Fe_2O_3)
10	52.31	1.75	38.99	024 (α-Al_2O_3)
11	54.32	1.69	46.41	116 (α-Fe_2O_3)
12	57.27	1.61	73.69	116 (α-Al_2O_3)
13	62.73	1.48	28.67	214 (α-Fe_2O_3)
14	64.26	1.45	28.65	300 (α-Fe_2O_3)
15	66.23	1.41	46.9	214 (α-Al_2O_3)
16	76.74	1.24	13.97	1010 (α-Al_2O_3)

Table S6: XRD lattice parameters of as-synthesized AlO_x-Fe_2O_3 nanocubes.

#	Peak position (2Θ)	Interplanar distance d (A°)	Intensity	Miller indices (hkl)
1	24.39	3.65	46.70	012
2	33.36	2.68	100	104
3	35.88	2.50	89.12	110
4	41.01	2.20	40.29	113
5	49.67	1.83	43.59	024
6	54.26	1.69	49.92	116
7	62.75	1.48	46.69	214
8	64.28	1.45	56.48	300
9	75.61	1.26	37.99	217

Table S7: XRD lattice parameters of as-synthesized AlO_x-Fe_2O_3 nanospheres.

#	Peak position (2Θ)	Interplanar distance d (A°)	Intensity	Miller indices (hkl)
1	24.39	3.65	44.78	012
2	33.36	2.68	100	104
3	35.88	2.50	88.65	110
4	41.01	2.20	37.82	113
5	49.67	1.83	40.33	024
6	54.26	1.69	47.22	116
7	62.75	1.48	46.21	214
8	64.28	1.45	56.45	300
9	72.16	1.31	25.26	1010
10	75.61	1.26	37.73	217

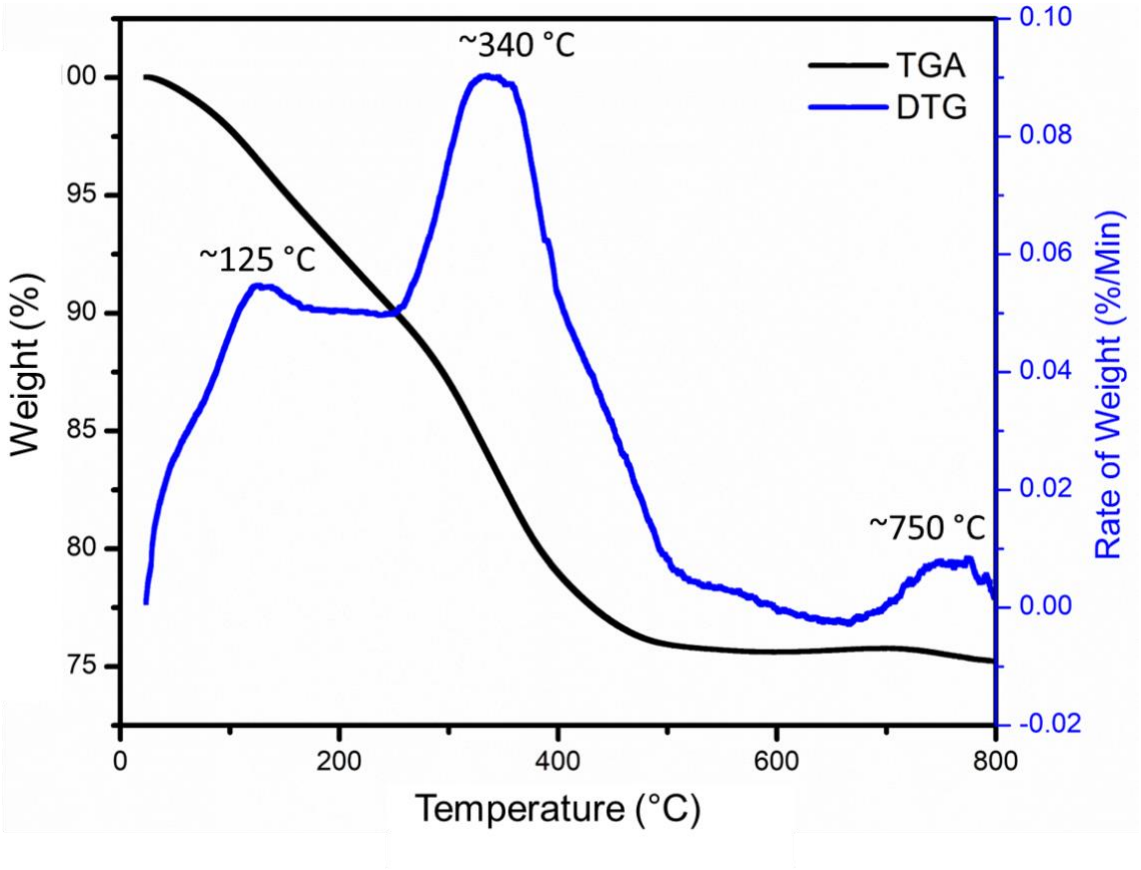

Figure S7: TGA and DTG graphs of bimetallic AlO_x-Fe_2O_3 nanorice (1:3 ratio).

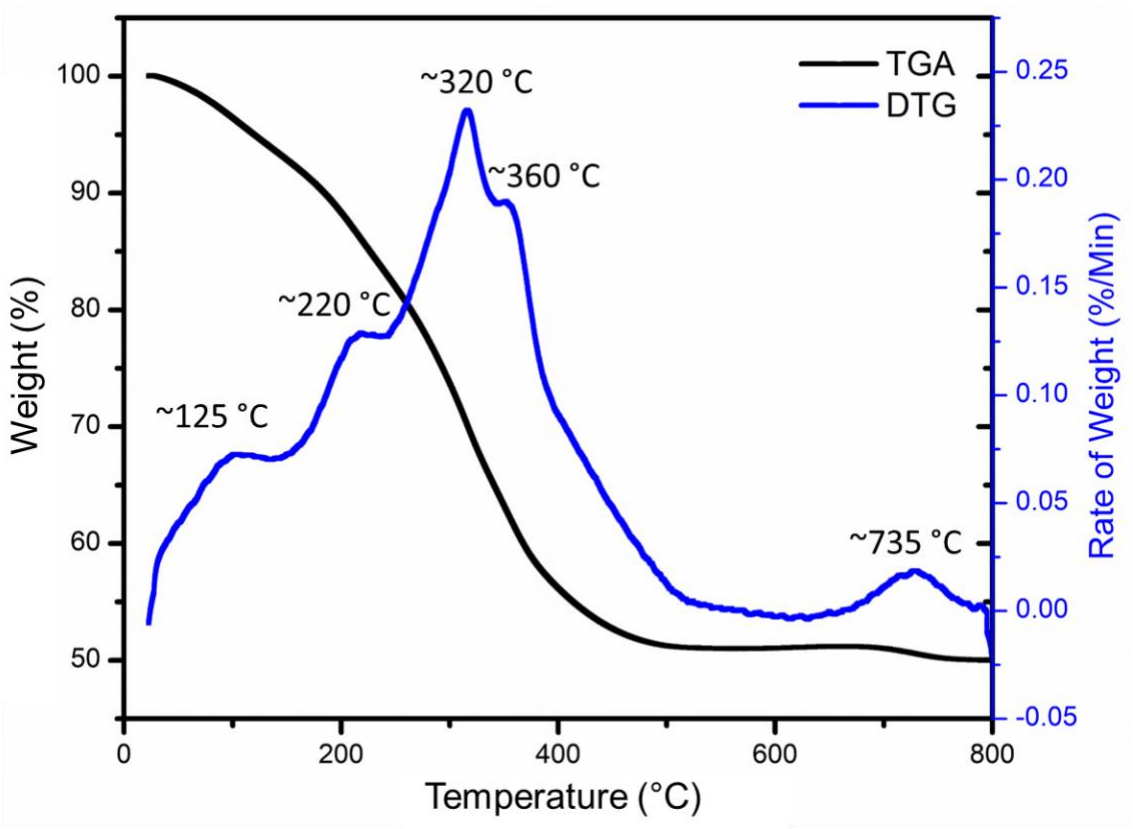

Figure S8: TGA and DTG graphs of bimetallic AlO_x-Fe_2O_3 nanocubes (1:5 ratio).

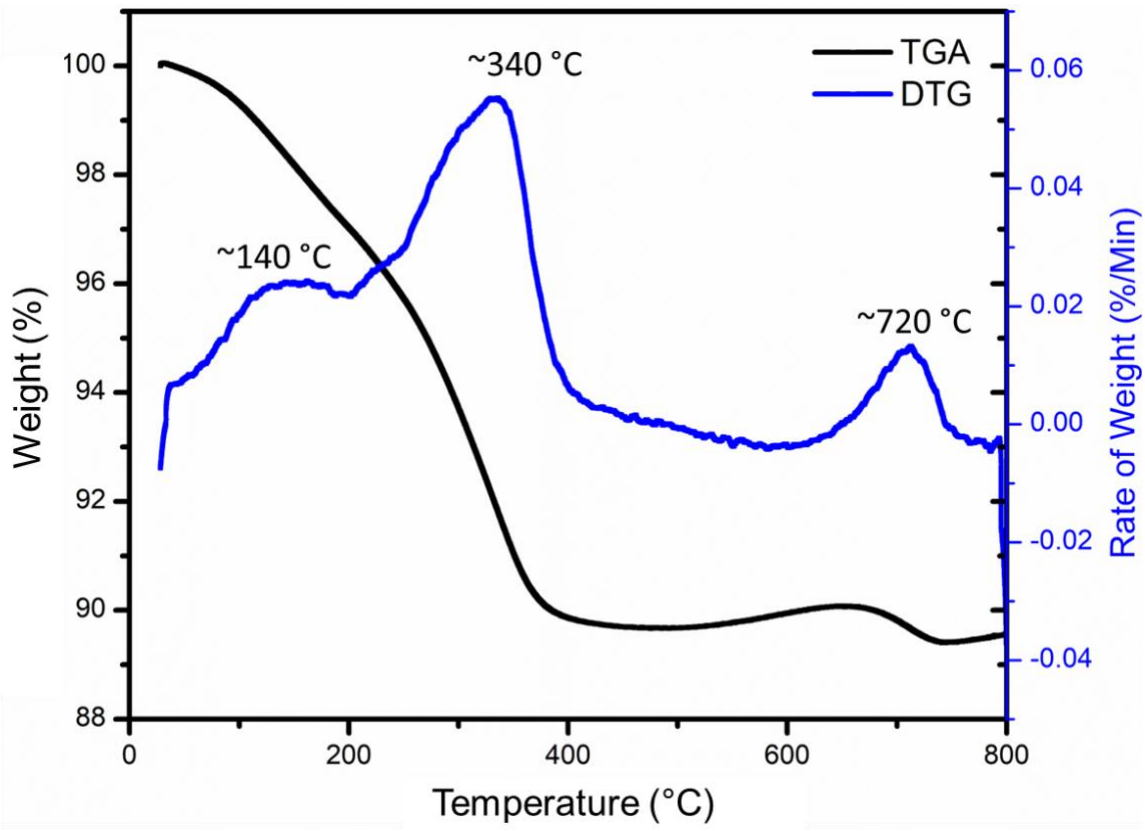

Figure S9: TGA and DTG graphs of bimetallic AlO_x-Fe_2O_3 nanospheres (1:10 ratio).