Electronic Supplementary Material (ESI) for RSC Advances

Electronic Supplementary Material

Synthesis of Eu^{3+}-doped Gd_2O_3 in Hollow Nanoparticle Structures by Controlled Chemical Etching with Poly(acrylic acid)

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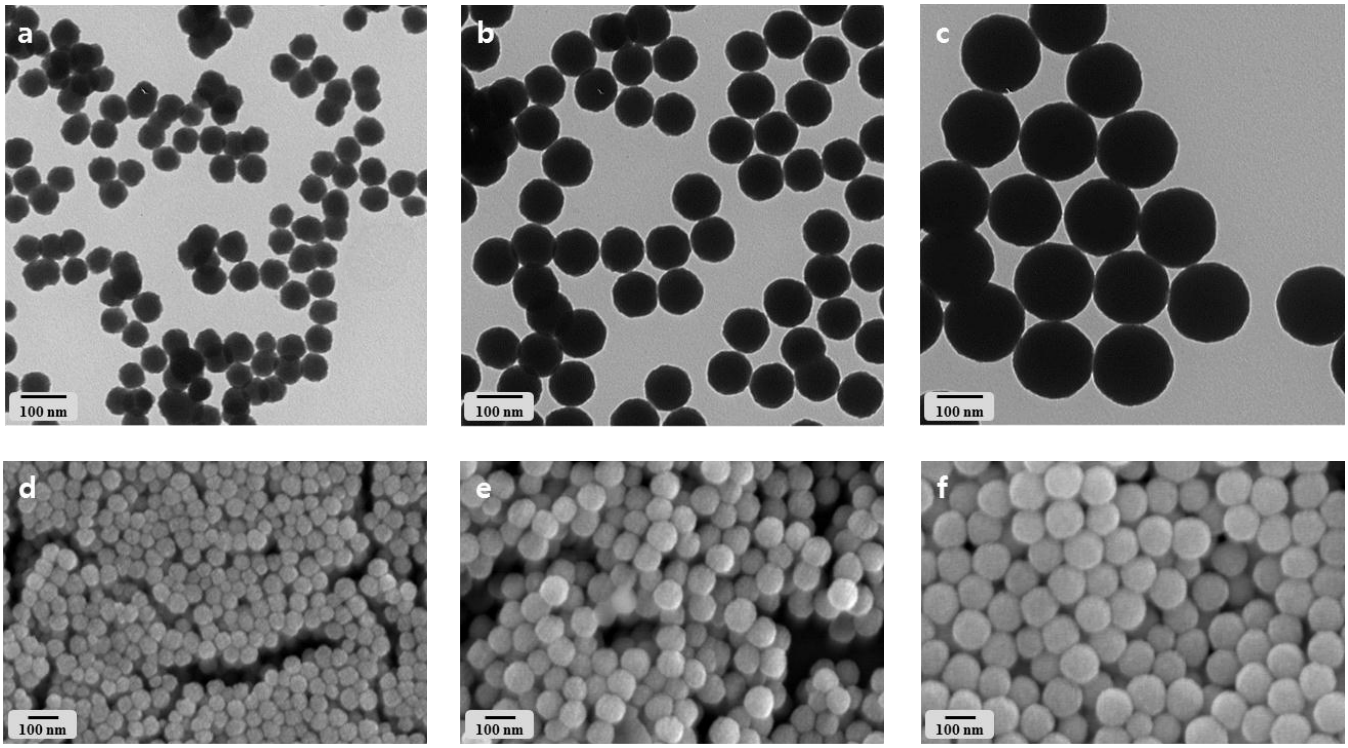

Figure S1. TEM and SEM images of Eu^{3+}:$Gd(OH)CO_3 \cdot H_2O$ nanoparticles with various sizes of (a, d) 60 nm, (b, e) 100 nm, and (c, f) 140 nm.

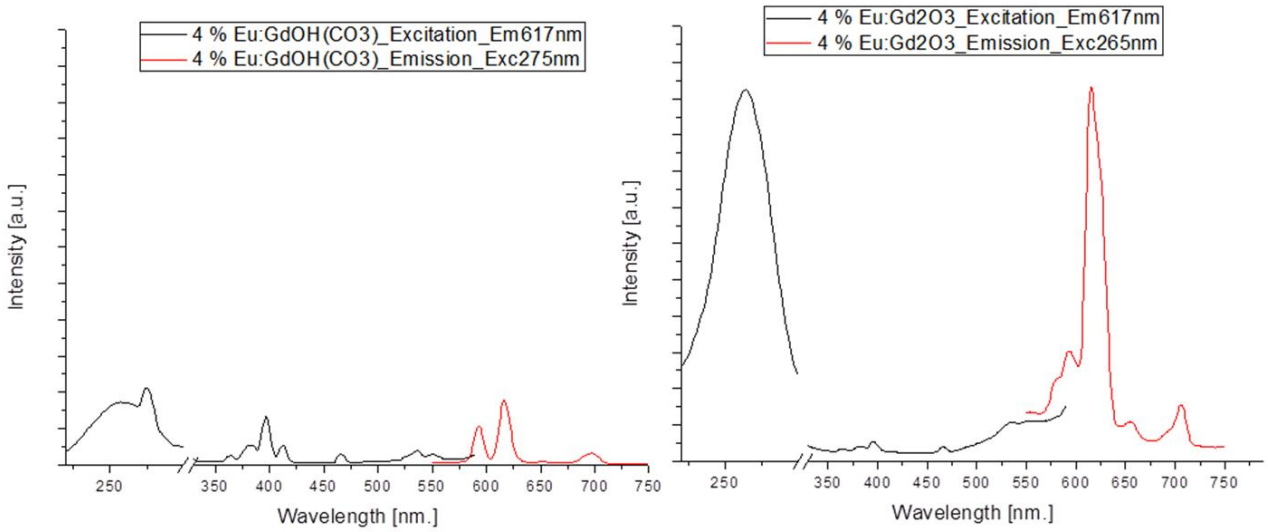

Figure S2. Photoluminescence excitation and emission spectra for (a) Eu^{3+}:$Gd(OH)CO_3 \cdot H_2O$ NPs and (b) Eu^{3+}:Gd_2O_3 NPs.

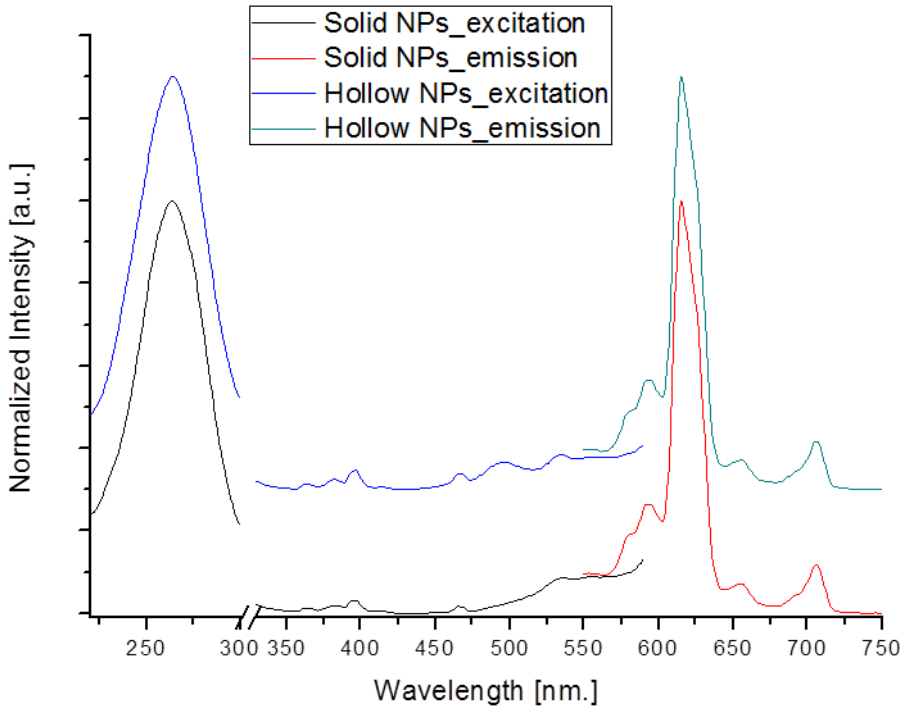

Figure S3. Photoluminescence excitation and emission spectra for (a) Eu^{3+}:Gd_2O_3 NPs and (b) hollow Eu^{3+}:Gd_2O_3 NPs.

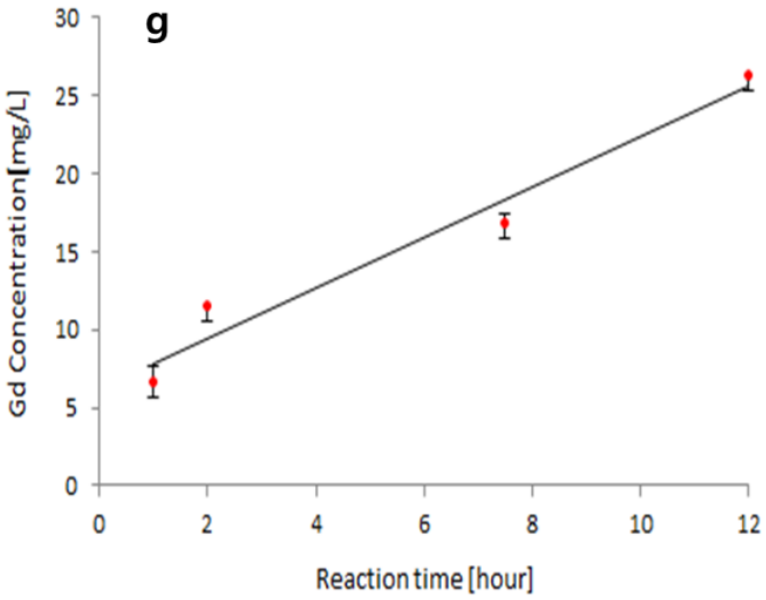

Figure S4. Etched amount of Gd^{3+} in the supernatants after the appropriate reaction times, measured by ICP-AES.

Table S1. Eu content from the mixing ratio and after annealing at 550 °C

Mixing condition (wt% of Eu)	ICP-AES results (averaged from 3 samples)		Average Eu content after annealing at 550 °C (wt% of Eu)
	Gd (mg/L)	Eu (mg/L)	
2%	57.88	1.79	3.09%
4%	67.57	3.55	5.25%
6%	69.53	6.19	8.90%
8%	77.91	7.75	9.95%
10%	83.43	12.34	14.79%

Table S2. Reported relaxivity data of representative Gd_2O_3-based T_1 contrast agents

Contrast agent	Diameter (nm)	r_1 ($mM^{-1}S^{-1}$)	r_2 ($mM^{-1}S^{-1}$)	r_2/r_1	B_0(T)	Specific condition	Ref.
Gd_2O_3 (sphere)	~352	22.2	128.9	5.8	3	0.5% agarose gel	16
Gd_2O_3 (cubic-like)	~423x294	19.5	89.4	4.6	3	0.5% agarose gel	16
Hollow Gd_2O_3	~200	17.7	26.6	1.5	3	0.5% agarose gel	22
	~200	2.78	-	-	4.7	0.5% agarose gel	23
Ultra small Gd_2O_3	2.2	8.8	11.4	1.3	7		13
	3.8	8.8	28.8	3.4	7		13
	< 3	9.4	13.4	1.4	1.5		14
	< 40	0.1	7.6	81.6	1.5		14
	1	9.9	10.5	1.1	1.5		17
Tb:Gd_2O_3	~4	12	-	-	1.5		20
Hollow Eu:Gd_2O_3	90	5.8	9.7	1.7	0.47		This work