SUPPORTING INFORMATION

Improving Lanthanide Nanocrystal Colloidal Stability in Competitive Aqueous Buffer Solutions Using Multivalent PEG-Phosphonate Ligands

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Figure S1. DLS CONTIN plot of oleate capped NaHoF₄ NPs in THF with a R_h of 12 nm.

Table S1. ¹H NMR T_1 and T_2 Relaxation Constants of PEG₂₀₀₀ samples.

	HO-PEG ₂₀₀₀ -OCH ₃		NH ₂ -PEG ₂₀₀₀ -OCH ₃		NH ₂ -PEG ₂₀₀₀ -NHBoc	
	T_1 (sec)	T_2 (sec)	T_1 (sec)	T_2 (sec)	T_1 (sec)	T_2 (sec)
PEG	1.19 ± 0.02	1.01 ± 0.01	1.16 ± 0.02	0.94 ± 0.01	1.11 ± 0.01	0.94 ± 0.01
End group (-OCH₃ or -tBoc)	3.14 ± 0.05	2.71 ± 0.08	3.24 ± 0.08	2.90 ± 0.15	1.25 ± 0.01	1.04 ± 0.02

Table S2 Values of R_h and PDI before and after ligand exchanged NaHoF₄ NPs.

NP	NaEuF ₄		NaGdF ₄		NaTbF ₄	
Ligand	OA*	Tetra**	OA*	Tetra**	OA*	Tetra**
R_h (nm)	7.1	10.9	6.3	10.3	8.0	10.8
PDI	0.13	0.23	0.16	0.20	0.07	0.11

*DLS measurements of OA capped NPs were conducted in tetrahydrofuran

**DLS measurements of tetraphosphonate-PEG-OCH₃ capped NPs were conducted in water

Table S3. DLS of Ligand exchanged NaHoF₄ NPs.

	Mono-phosphate-PEG-OCH ₃			Di-phosphonate-PEG-OCH ₃			Tetra-phosphonate-PEG-OCH ₃			
	3	7	9**	3	7	9**	3	7	9	7.4*
R_h (nm)	25.8	23.8	-	19.5	20.9	-	18.2	21.3	32.1	24.4
PDI	0.43	0.27	-	0.25	0.18	-	0.19	0.23	0.19	0.18

*conducted in PBS

**Not determined due to the presence of aggregates

Figure S2. ¹H NMR spectrum of di-phosphonate-PEG-OCH₃ (4).

Figure S3. ¹H NMR spectrum of tetra-phosphonate-PEG-OCH₃ (**10**).

Figure S4. ¹H NMR spectrum of tetra-phosphonate-PEG-NH₂ (13).