Supporting information

Europium-doped $NaGd(WO_4)_2$ nanophosphors: synthesis, luminescence and their coating with fluorescein for pH sensing

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Estimation of the amount of fluorescein on the NP surface

Table S1: Data from the TG analysis of the citrate capped Eu^{3+}(6%):$NaGd(WO_4)_2$ sample coated PAH-fluorescein.

Sample	Initial (RT)		Adsorbed water (up to 200 °C)		Citrate + PAH-F (200 – 500 °C)		Final (750 °C)	
	Mg	%	mg	%	mg	%	mg	89.1
NPs@cit @PAH-F	2.629	100	0.115	4.5	0.163	6.4	2.349	89.1

In the data shown in Fig. 7 the final weight value at 750 °C for the PAH-fluorescein coated NPs was 2.349 mg, which corresponded to 89.1 % of the initial weight. We assume that at this temperature only NP cores are present. For a spherical NP with core diameter d_c= 119 nm, the volume is $V_c = (4\pi/3)\cdot(59.5\ nm)^3 \approx 882.3 \cdot 10^3\ nm^3$. Given the bulk density of $NaGd(WO_4)_4$ = 7.18 g/cm^3, the mass of one $NaGd(WO_4)_2$ core thus is $m_c = 7.18\ g/cm^3 \cdot 882.3 \cdot 10^3\ nm^3 \approx 6.33 \cdot 10^6\ g\cdot(10^{-9}\ m/10^{-2}\ m)^3 = 6.33\cdot10^{-15}$ g. The number of NPs can be thus calculated:

$$2.349\cdot10^{-3}g\cdot\frac{1\ NP}{6.33\cdot10^{-15}g} = 3.71\cdot10^{11}NPs$$

By comparing the TG data with the as synthesized NPs (i.e. citrate capped NPs, in which a 4.8 % weight loss was observed between 200 and 500 °C), the amount of PAH-fluorescein is estimated to be 1.6 % (6.4 – 4.8 weight %), in this case 0.0421 mg. The proportion poly(allylamine hydrochloride) : fluorescein isothiocyanate is 50:1, meaning that every 3239.4 mg of PAH-fluorescein (50 mmol of PAH monomers · 57 mg/mmol + 1 mmol of fluorescein isothiocyanate · 389.4 mg/mmol) contain 389.4 mg of fluorescein isothiocyanate, then:

$$0.0421\ mg\ PAH-fluorescein\cdot\frac{389.4\ mg\ fluorescein}{3239.4\ mg\ PAH-fluorescein}\cdot\frac{1\ mmol\ fluorescein}{389.4\ mg} = 1.30\cdot10^{-8}\ mol\ fluorescein$$

Such amount of fluorescein is associated with $3.71 \cdot 10^{11}$ NPs, then:

$$\frac{mol\ fluorescein}{NP} = \frac{1.30 \cdot 10^{-8}}{3.71 \cdot 10^{11}} = 3.51 \cdot 10^{-20}\ mol\ fluorescein\ per\ NP$$

$$3.51 \cdot 10^{-20}\ \frac{mol\ fluorescein}{NP} \cdot \frac{6.023 \cdot 10^{23}\ molecules}{mol} \approx 21100\ molecules\ of\ fluorescein\ per\ NP$$