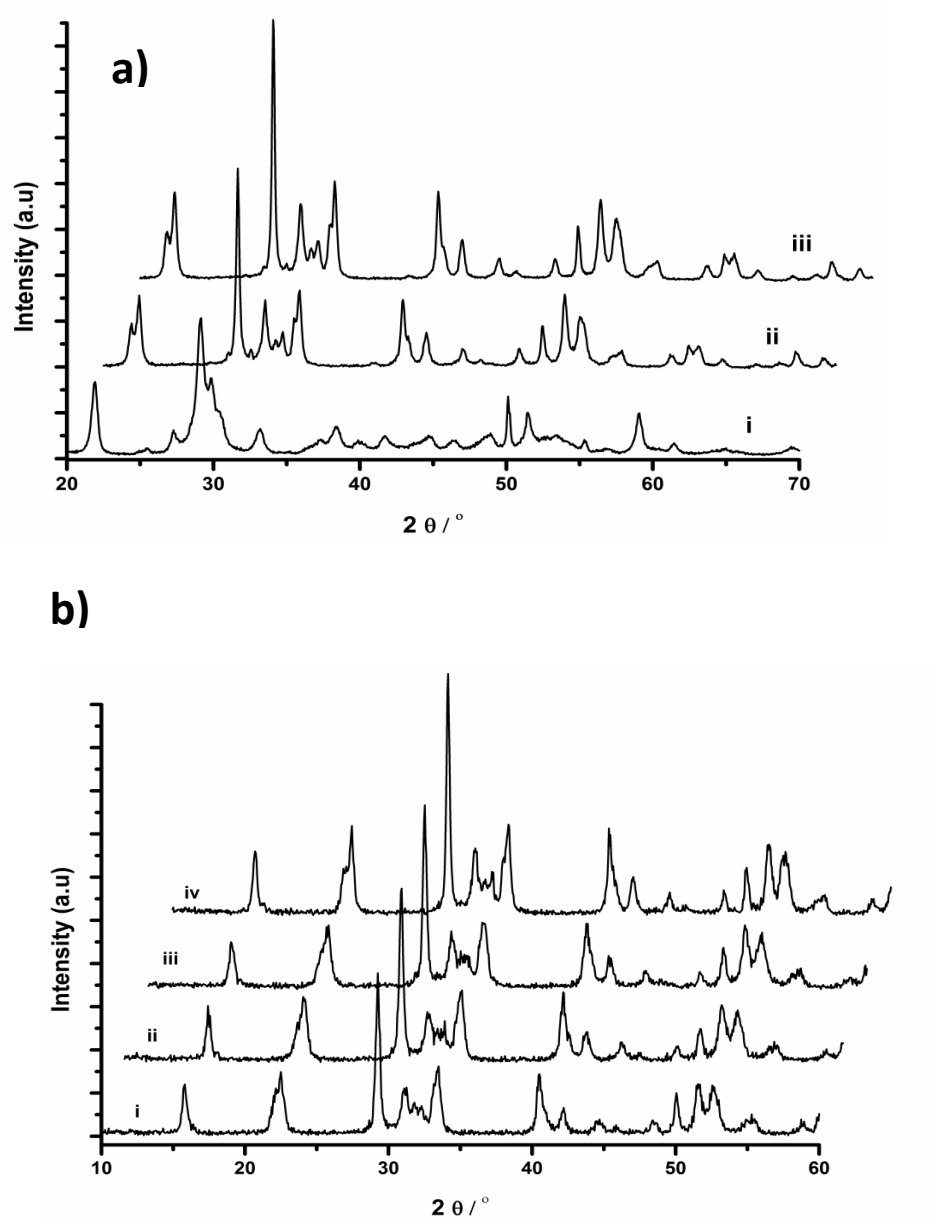
Supplementary figures:

Supplementary equation S1

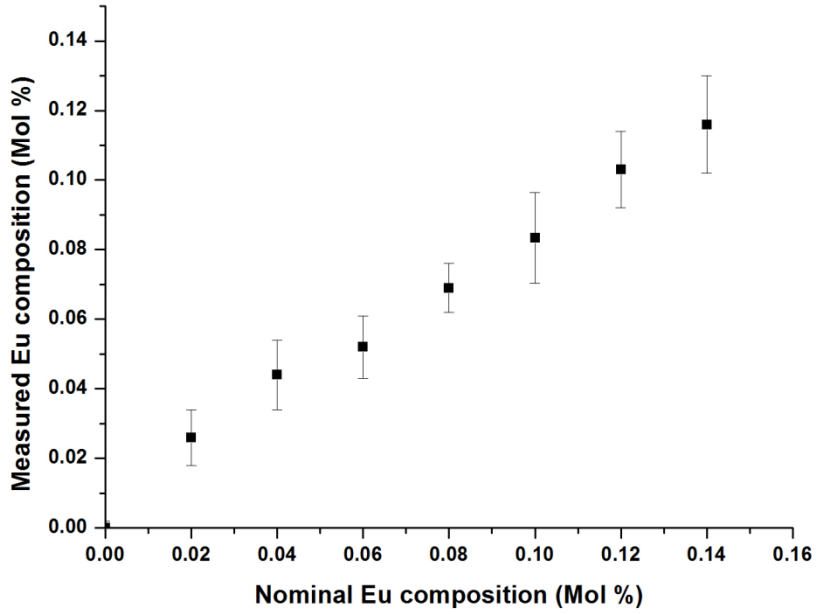
$$1\text{-}x\ Y(NO_3)_{3\,(aq)} + x\ Eu(NO_3)_{3(aq)} + 6\ KOH \rightarrow Y_{1\text{-}x}\ Eu_{\ x}\ (OH)_{3\,(s)} + K(NO_3) + 5H_2O$$

Supplementary equation S2

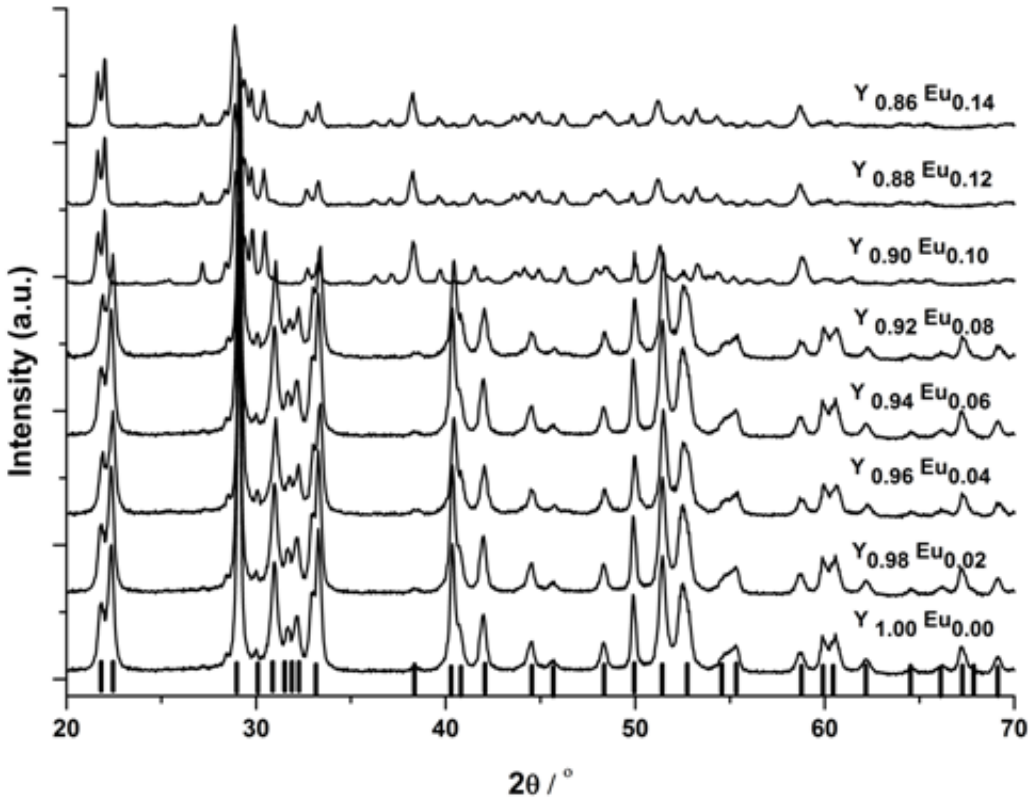
$$1\text{-}x\ Y(NO_3)_3 + x\ Eu(NO_3)_3 + KOH \rightarrow Y_{1\text{-}x}\ Eu_{\ x}\ (OH)_3 \rightarrow (Y_{1\text{-}x}\ Eu_{\ x})OOH + H_2O$$



Supplementary Figure S1: **a)** XRD patterns of the products obtained from experimental runs 1-3 synthesised with different concentrations of KOH in the auxiliary feed **i)** 0.5M **ii)** 1.0 M **iii)** 2.0M **b)** XRD patterns obtained for the reaction products obtained from reactions (run 4-7) produced with the addition of hydrogen peroxide **i)** 0.2 M **ii)** 0.4 M **iii)** 0.6M **iv)** 0.8M



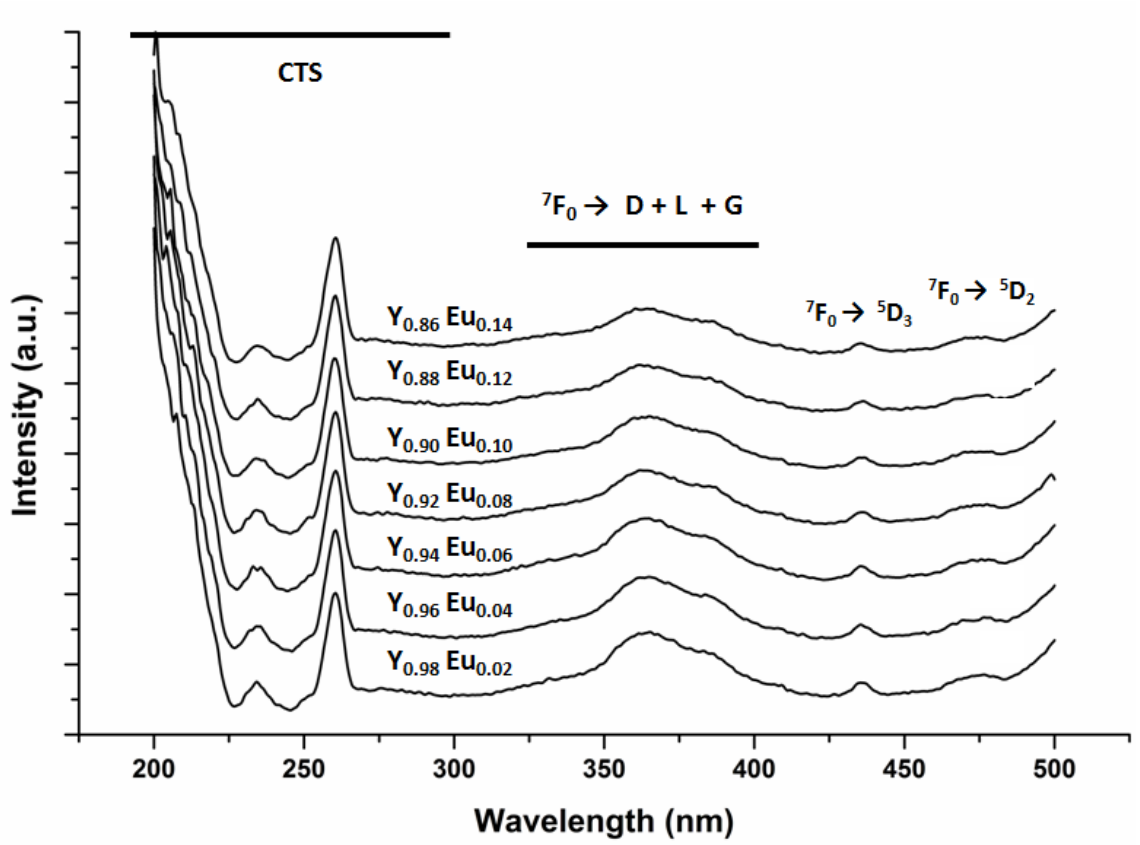
Supplementary Figure S2: Comparison of the nominal Eu concentration used in the synthesis of $(Y_{1-x}\ Eu_x)OOH$ nanoparticles compared to the atomic ratios measured using EDX [error bars indicate the standard deviation of 10 measurements].



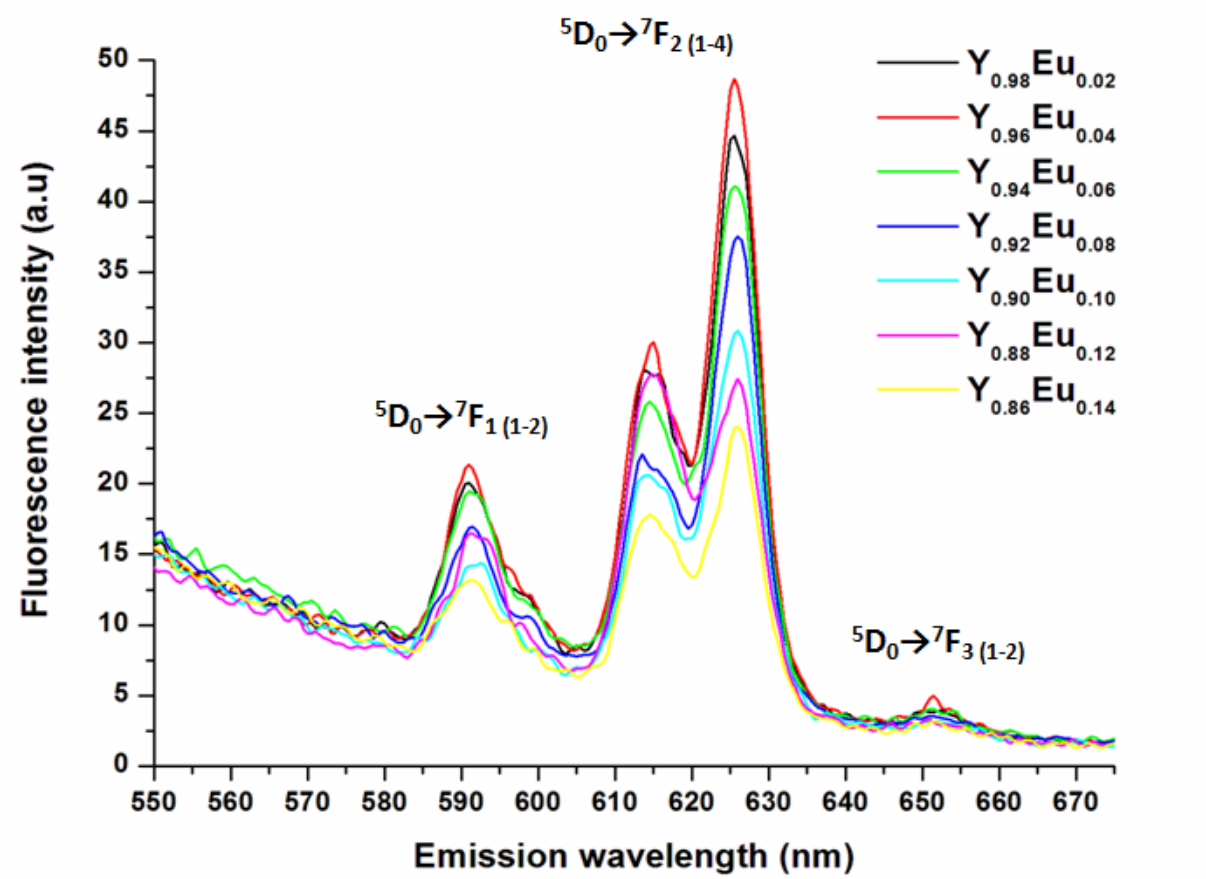
Supplementary Figure S3: a) Stacked powder diffraction patterns obtained for $(Y_{1-x}Eu_x)OOH$ (where, x = 0.00-0.14) phosphor materials synthesised directly using CHFS. [Pattern index shows reflections from reference ICDD pattern 28442]

Supplementary Table ST1: Summary of Lattice parameters determined by le-bail fitting for (Y_{1-x} Eu_x)OOH (where, x = <0.10)

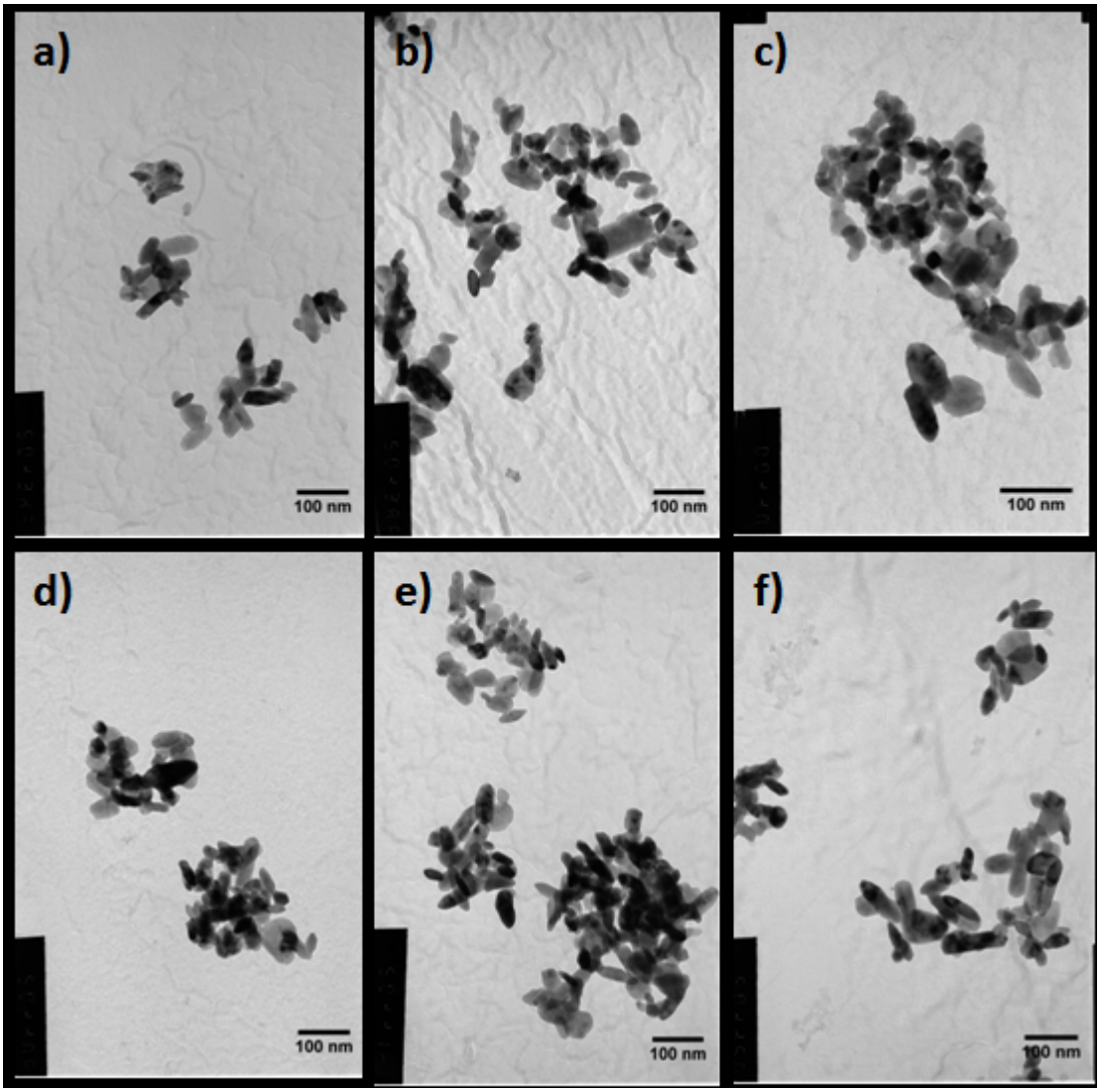
Sample	Phase	Lattice parameter (Å)			R_p	R_{wp}
		a	b	c		
$Y_{1.00}$ $Eu_{0.00}$	P_{121}/M_1	4.282	3.660	6.071	0.073	0.060
$Y_{0.98}$ $Eu_{0.02}$	P_{121}/M_1	4.285	3.670	6.079	0.0802	0.084
$Y_{0.96}$ $Eu_{0.04}$	P_{121}/M_1	4.289	3.671	6.101	0.038	0.028
$Y_{0.94}$ $Eu_{0.06}$	P_{121}/M_1	4.299	3.678	6.109	0.031	0.034
$Y_{0.92}$ $Eu_{0.08}$	P_{121}/M_1	4.294	3.683	6.112	0.026	0.022



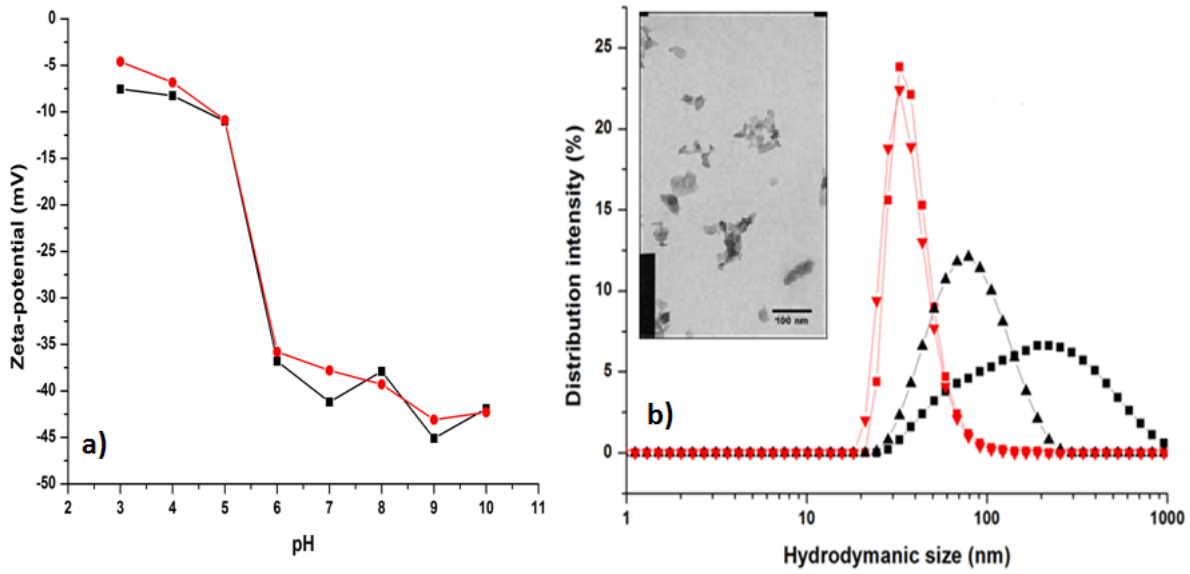
Supplementary Figure S4: Excitation spectra ($\lambda_{emission}$ 617 nm) recorded for nanoparticles produced in the composition series ($Y_{1-x}Eu_x$)OOH (where x = 0.00 - 0.14).



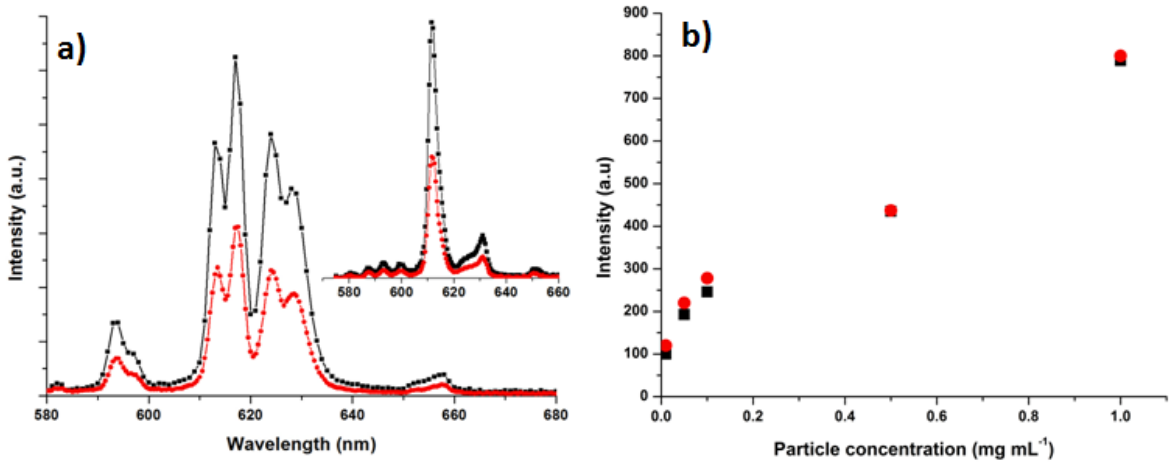
Supplementary Figure S5: Photoluminescence spectra ($\lambda_{excitation}$ 254 nm) recorded for nanoparticles produced in the composition series $(Y_{1-x}Eu_x)OOH$ (where x = 0.00-0.14).



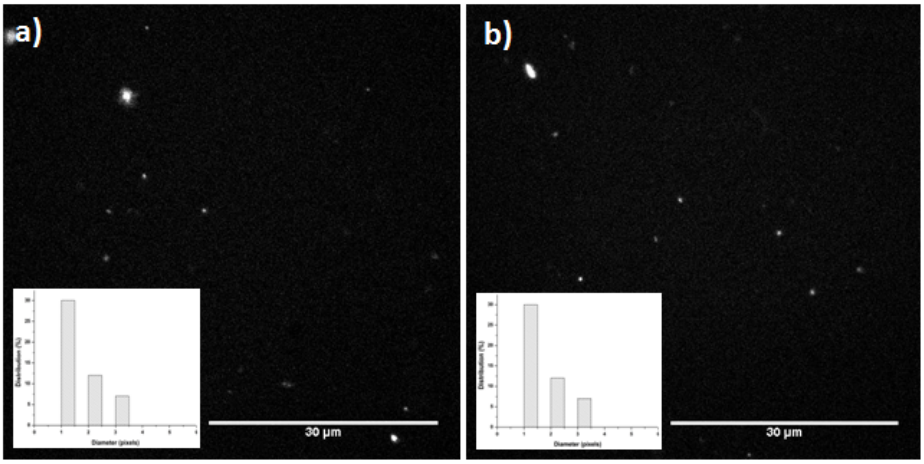
Supplementary Figure S6: TEM images of $(Y_{0.96}Eu_{0.04})OOH$ phosphor nanoparticles heat treated at 500 °C for **a)** 60 s **b)** 180 s **c)** 300 s **d)** 600 s **e)** 1200 s **f)** 1800 s (Images were captured using JEOL 100CX)



Supplementary Figure S7: a) Zeta-potential titration of citric acid coated $(Y_{0.96}Eu_{0.04})_2O_3$ (squares) and ($Y_{0.96}$: $Eu_{0.04}$) OOH (circles), b) Intensity weighted hydrodynamic diameters of **citric acid coated** $(Y_{0.96}Eu_{0.04})_2O_3$ (black squares) and $(Y_{0.96}Eu_{0.04})$OOH (black triangles) and the corresponding distribution corrected to show distribution by number (red symbols) [Inset shows a TEM image of citric acid coated $(Y_{0.96}Eu_{0.04})_2\,O_3$].



Supplementary Figure S8: a) comparison of the fluorescence intensity of $(Y_{0.96}Eu_{0.04})$OOH (main) and $(Y_{0.96}Eu_{0.04})_2O_3$ (inset) nanoparticles [squares] and their citric-acid coated derivatives [circles] **b)** Pl intensity data (λ_{em} 620± 10 nm) of optical phantoms containing various concentrations of coated nanoparticles (Squares, $(Y_{0.96}Eu_{0.04})_2O_3$ and circles $(Y_{0.96}Eu_{0.04})$OOH) excited at 470 nm.



Supplementary Figure S9: The diameter of fluorescence signals from nanoparticles dispersed on cover-glass visualised using 470 nm excitation / 620 nm emission **a)** citric acid coated $(Y_{0.96}Eu_{0.04})OOH$ nanoparticles **b)** citric acid coated $(Y_{0.96}Eu_{0.04})_2O_3$ nanoparticles (insets show the measured diameter of fluorescence signals).