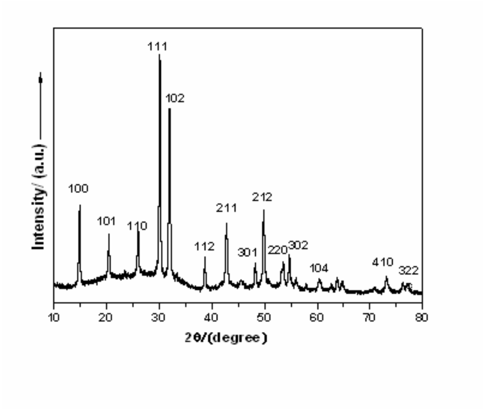
Electronic Supplementary Information

Experimental Methods:

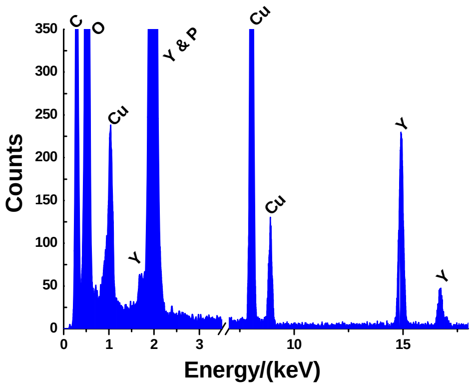
All chemicals were of analytical grade and were used as received without further treatment. Deionized water was used throughout. In a typical synthesis of hexagonal $YPO_4 \cdot 0.8H_2O$ NCs, 1.2g NaOH was added to the mixture of 20ml oleic acid (OA) and 20ml ethanol and stirring for a while. 0.2M NaH_2PO_4 solution (5ml) and 0.2M $Y(NO_3)_3$ (5ml) solution were added to the mixture solvent, the white precipitate of amorphous YPO4 appeared immediately. After stirring for about 0.5 hour, the mixture was transferred into a 50ml autoclave, which filled with ethanol, sealed and heated at ca. 100-140℃ for 12 – 8 hours. The system was then allowed to cool to room temperature. The final white products spontaneously separate in bottom of the autoclave. Doped samples were prepared as above, except that additional 10% (total molar ratio) $Eu(NO_3)_3$ was added into the system and doped smaples exhibit orange-red luminescence..

The products were characterized by a Bruker D8 Advance X-ray diffractmeter (XRD) with Cu Kα radiation (λ=1.5418Å). The operation voltage and current were kept at 40KV and 40mA, respectively. The size and morphology of the nanocrystals were examined with a JEOL JEM-1200EX transmission electron microscope (TEM) and a Tecnai F20 high-resolution transmission electron microscope (HRTEM). SAED patterns were recorded by transmission electron microscopy. Raman (Renishaw RM 1000 Raman spectrometer, excitation wavelength 633nm) and Fourier transform infrared spectra (Perkin-Elmer Spectrum GX) were used to characterize the structure of the samples. Electron energy loss spectra (EELS) measurement was performed with a Gantan parallel detection spectrometer attached to a JEOL JEM-2010F transmission electron microscope. Fluorescent spectra were recorded with a Hitachi F-4500 Fluorescence Spectrophotometer.

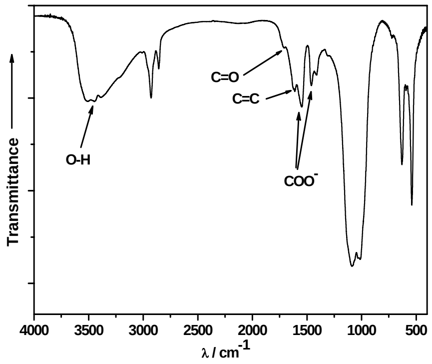
SFigure 1 XRD pattern of Yttrium Phosphate hydrate NCs.



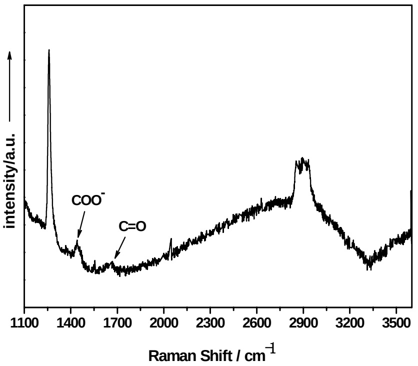
SFigure 2 EDXA spectrum of products.



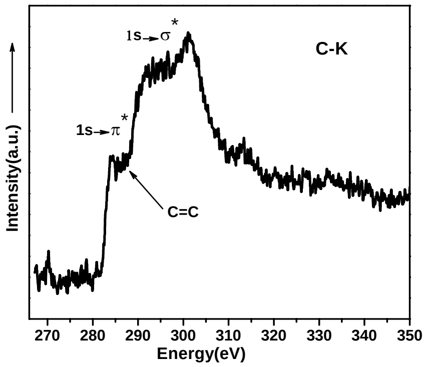
SFigure 3: a) FTIR spectrum of H-NCs. The vibration band at 1704 and 1610cm^{-1} is attributed to C=O and C=C vibrations respectively. Two characteristic bands appear at 1546 and 1456 cm^{-1}corresponding to the antisymmetric νs (COO$^-$), and the symmetric νs (COO-), stretches respectively. The O-H stretching vibrations broad bands centered at 3510cm^{-1}, and 2927cm^{-1}, 2856cm^{-1} are assigned to the antisymmetric and symmetric methylene stretches (νas (CH2), νs (CH2)) of the oleic acid molecule which implied the existence of large amounts of alkyl chain. The broad band centered at 1078cm^{-1} and 1012cm^{-1}, as well as 630cm^{-1} and 540cm^{-1}, come from hexagonal YPO4 • 0.8H2O, b) Raman spectrum of H-NCs. The bands center at 1440 cm^{-1} and 1660 cm^{-1} are attributed to COO- and C=O vibrations respectively, and the others are due to alkyl chain vibrations, c-d) EELS by core-level excitations: EELS spectra at C-K edge (c) and O-K edge (d). The observed initial peak in the carbon K-edge spectrum located around 284.5eV is attributed to 1s→π* transitions suggested C atoms in the uncrystallized overlayer are sp^2 hybridized in agreement with the existence of C=C in OA molecules. The energy loss starting at 291eV revealed C atoms 1s→ σ * transitions. The peak at 532eV in O-K edge spectrum is attributed to O atoms 1s→ σ * transitions mainly coming from carboxyl of OA.



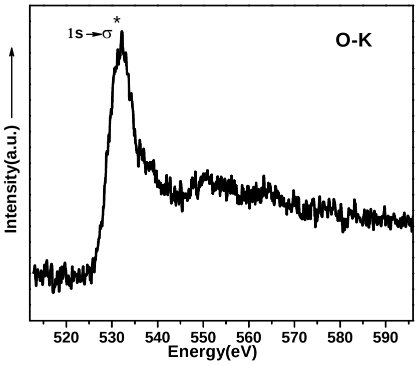
SFigure 3a



SFigure 3b



SFigure 3c



SFigure 3d

SFigure 4 Re-dispersibility of H- Yttrium Phosphate hydrate NCs: a) As-obtained H- NCs completely dispersed in hexane. (The system can be stable for several days) b) NCs were precipitated after adding alcohol into the system c) NCs were precipitated in the bottom and the solvent become transparent and almost colorless. d) NCs deposition was separated from the system and re-dispersed into hexane