Supporting Information

In-situ formation of luminescent CdSe QDs in a metallohydrogel: a strategy towards synthesis, isolation, storage and re-dispersion of QDs

Sayantan Chatterjee and Uday Maitra*
Department of Organic Chemistry, Indian Institute of Science,
Bangalore: 560012, India
*Email: maitra@orgchem.iisc.ernet.in

Table of Contents

POM, AFM, SEM and TEM imaging of gel–CdSe QD hybrid material

POM, AFM, SEM and TEM imaging were carried out on Olympus C3040-ADU, JPK NANO WIZARD II, FEI sirion XL30 FEG SEM instruments and JEOL 2100F, respectively. For POM, wet hybrid gel was drop cast on glass slide before experiment. The gel–QD hybrid material was drop cast on mica sheet and dried under reduced pressure for AFM imaging. AFM measurements were carried out in tapping mode at a scanning rate of 1.0 Hz. For SEM, the dried gel (xerogel) sample was drop cast on silicon wafer and coated with gold of thickness ~10 nm. The operating voltage for FESEM was 20 KeV. For TEM imaging gel–QD hybrid was drop cast on a carbon-coated copper grid (400 square mesh) and followed by high vacuum drying. Then sample was staining with 0.1% uranyl acetate. The operating voltage for FETEM was 200 KeV.

UV-visible, fluorescence, photoluminescent quantum yield and time resolved spectroscopy of gel–QD hybrid

Absorption and Fluorescence measurements were carried out on a Shimadzu UV-3600 spectrophotometer and Varian Cary Eclipse fluorescence spectrometer. UV-visible absorption and emission spectra of the metallohydrogel–QD hybrid were recorded on a UV-Vis spectrophotometer and emission at room temperature using quartz cuvette. The photoluminescent quantum yields were recorded on Edinburgh Instruments FLS980 fluorescence spectrometer equipped with an integrating sphere. A light emitting diode (FLSP920) at 405 nm was used as excitation source for time resolved spectroscopy measurements. Fitting and analysis was performed using Origin8.

Reaction condition

The alkaline condition is required for the formation of CdSe QDs, which was attained by the excess sulphite, used during the preparation of a selenium precursor solution. The pH of the reaction mixture was ~8.

$$Cd^{2+} + SeSO_3^{2-} + 2OH^- \longrightarrow CdSe + SO_4^{2-} + H_2O$$

POM and SEM images of the pristine gel

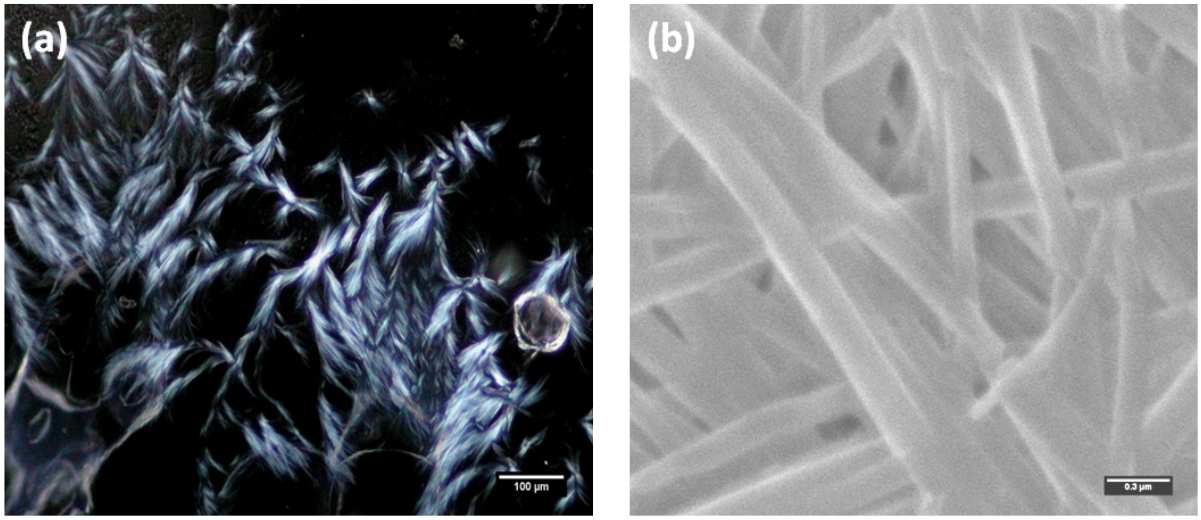

Fig S1. (a) POM and (b) SEM images of the pristine gel.

Additional TEM images of H-3

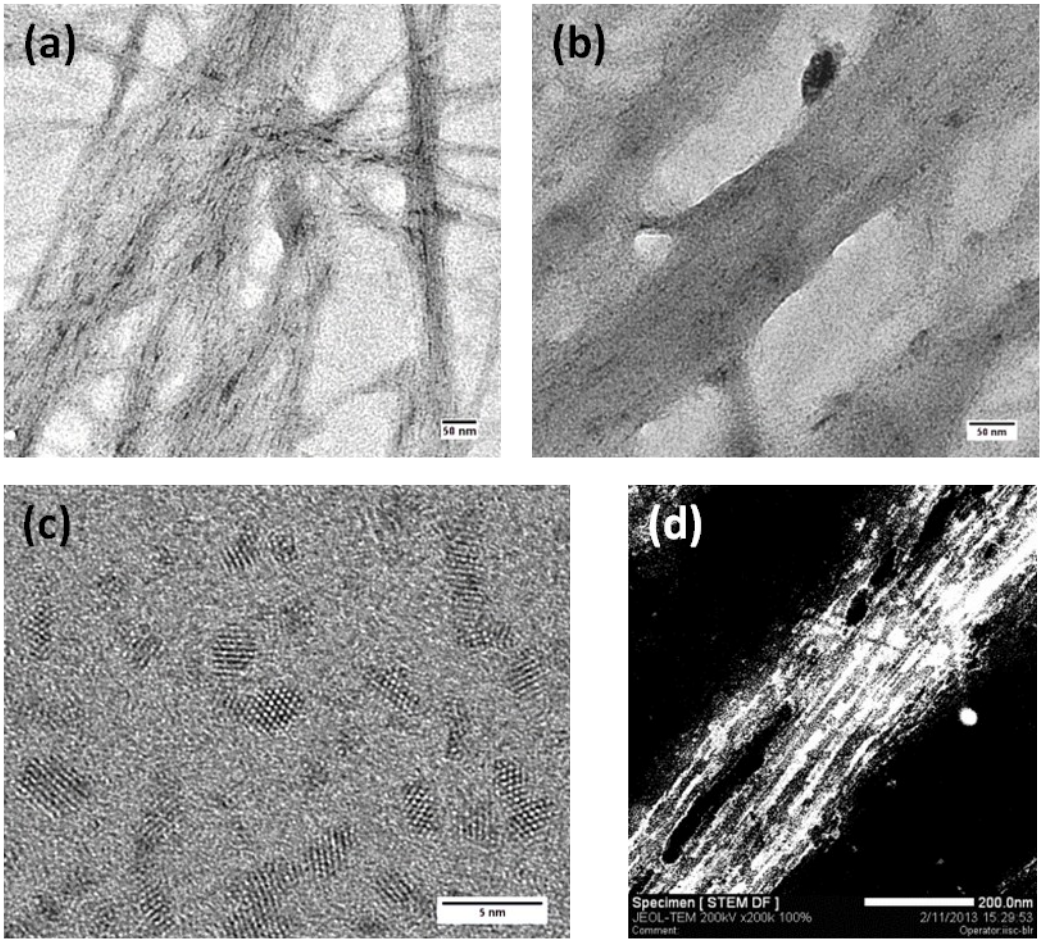

Fig S2. (a, b) TEM, (c) HRTEM and (d) STEM (DF) images of H-3.

X-ray powder diffraction study

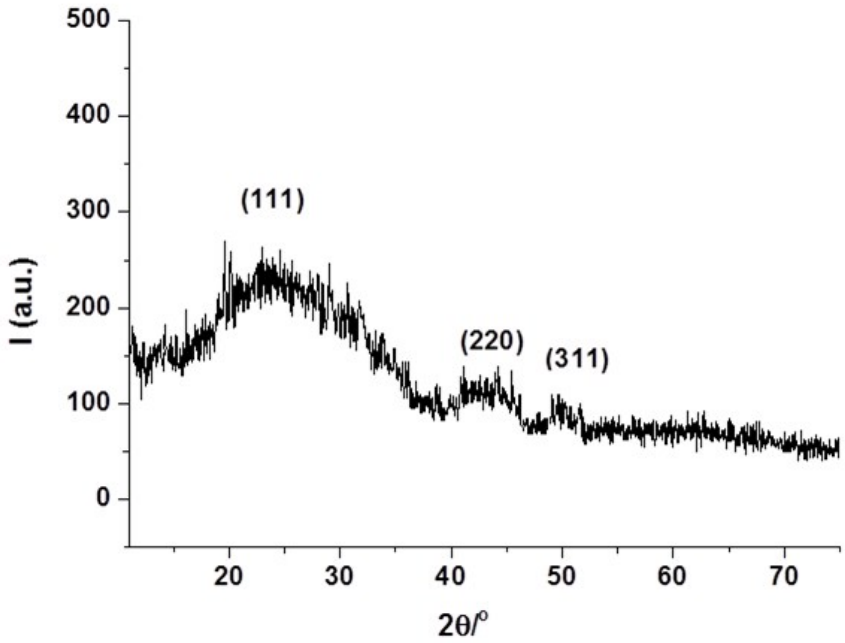

Fig S3. Powder XRD patterns of gel-QD hybrid (xerogel).

The pXRD pattern of CdSe QD in gel has three major peaks at the angles (2θ) of 25.4°, 42.3° and 49.9°, which were indexed as (111), (220) and (311) planes, respectively, suggesting cubic CdSe crystal lattice (JCPDS File No. 19-0191).

Effects of aging on the hybrid gel (H-3)

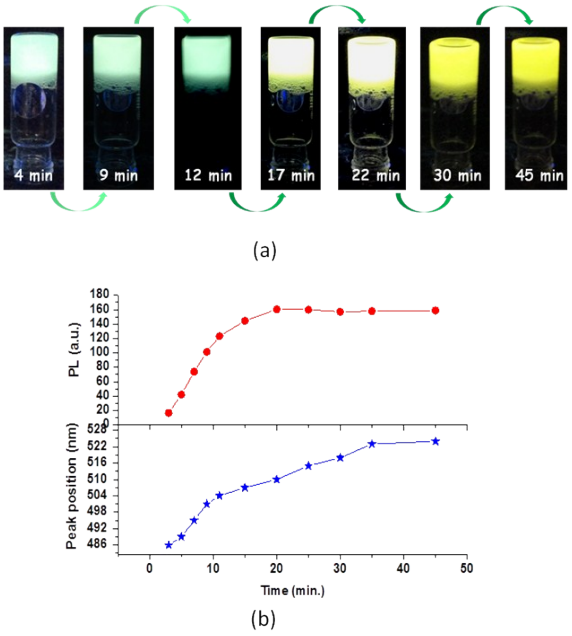

Fig S4 (a) Photograph of H-3 at different time intervals and (b) effect of aging on spectral data of H-3 at 25 °C.

Fig S4 shows the effect of aging on the emission color for the hybrid H-3. With time, the emission maximum shifted to a higher wavelength with increasing luminescent intensity, indicating aggregation to larger CdSe QDs inside the gel network. This suggested that while the gel network was not able to completely stop aggregation, it significantly reduced it. Of course, in the absence of the gel agglomeration leads to rapid precipitation of the CdSe. This aging process restricted the final size of the QD to its yellow emitting stage as shown in Fig S4a.

Emission spectra of H-3 at different excitation wavelengths

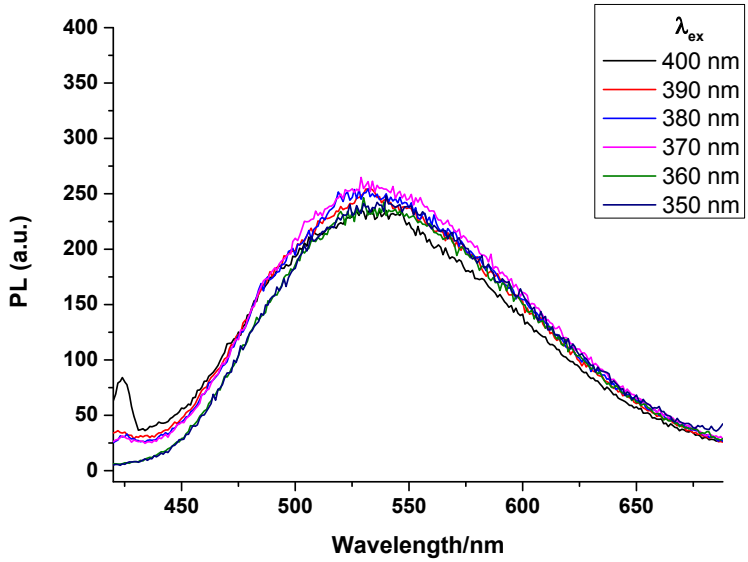

Fig S5 (a) PL emission spectra of H-3 excited with varying wavelengths from 350nm to 400nm.

Since the peak positions of the PL emission of H-3 remain unshifted as the excitation wavelength changes, emission spectra of H-3 were independent of the excitation wavelength at which the QD was excited.[1]

References

1. S. Ge, L. Zhang, P. Wang and Y. Fang, *Sci. rep.*, 2016, **6**, 27307.