

Transparent, Flexible and Luminescent Composite Films by Incorporating CuInS₂ based Quantum Dots into Cyanoethyl Cellulose Matrix

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Supplementary Information for Chemical Communications

Experimental

Materials:

CuInS₂-ZnS QDs were prepared by with oleic acid as a ligand and an emission peak from 500 to 800 nm, concentrations of 1.17–1.77 mg/mL and approximate quantum yields of 40–65% were synthesized by our previous published methods. Cycnoethyl cellulose (M5, DS=2.94) were prepared by using a published method. Rhodamine B from Chroma Gesellschaft (Schmid & Co.) was used.

Solution preparation:

QD and polymer solutions were prepared individually and were subsequently mixed according to volume in order to form the QD–polymer mixtures. The QD in DMF solution was prepared using a ligand-exchange phase transfer procedure as follow. The as-received QDs (25 mg ml⁻¹ in toluene) were precipitate by acetone and collected by centrifuging, then the precipitated QDs were mixed with a mixture of mercaptopropionic acid/DMF =1:5 volume ratio in a centrifuge tube and ultrasonicated (R-08895-14, Cole Parmer) for 20 min.

The polymer solution was prepared by dissolving dry CEC in N, N'-dimethylformamide (DMF) under 60°C at 5 mg ml⁻¹, and ultrasonicated for 3 h, shaking at several intervals. The QD and CEC solutions were mixed according to volume to make approximate 2.5, 5.0, 10.0, and 25.0 wt% QD solutions.

Film Preparation:

Solutions of CuInS₂ based QDs and CEC in DMF were mixed according to volume to make approximate 2.5, 5, 10, and 25 wt% QD solutions. The mixed solutions were poured into glass Petri dishes. The samples were left in the oven under vacuum at 60°C for 24 hours to completely evaporate the solvent. Finally, the films were carefully peeled off from the glass surface. The films are flexible transparent, and have thicknesses on the order of ~0.5 mm, depending on the amount of casting solution. The films are quite flexible and can be cut into different patterns.

Measurements

The absorption spectra of hybrid composite films were measured by using Cary 300 BIO

UV-vis spectrometer (Varian). The PL spectra were taken using a FP-6600 luminescence spectrometer. The PL QYs of samples were measured by using Rhodamine B in PMMA matrix (0.05 wt %, QY: 97%) as a standard reference and comparing the integrated PL intensities. The thermogravimetric analysis (TGA) measurements were carried out with 10-15 mg samples on a Shimadzu TG-50 apparatus under nitrogen purge (70 ml min^{-1}) with a heating rate of $2 \text{ }^{\circ}\text{C min}^{-1}$ in the range from ambient temperature to 600°C .

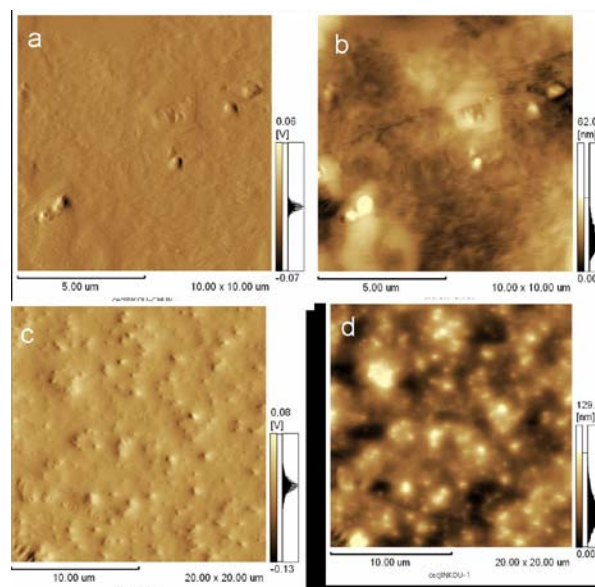


Fig. S1. AFM images of hybrid composite films with the 5 wt% CuInS₂/ZnS-QDs content (a, b) and hybrid composite films with the 25 wt% CuInS₂/ZnS-QDs content (c, d).

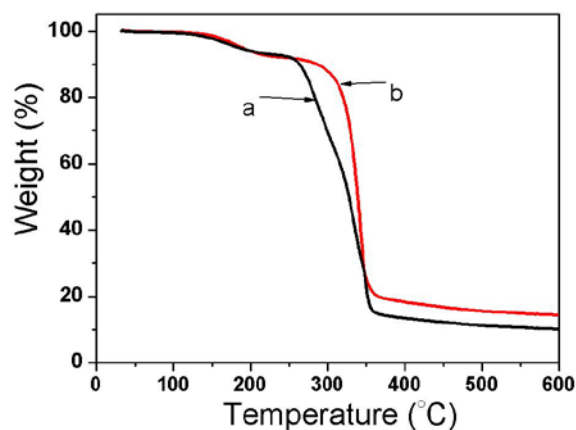


Fig. S2. Thermo-Gravimetric analysis curve of (a) pure CEC, and (b) hybrid composite film with 10 wt % QDs.