Electronic supplementary information (ESI)

New synthesis of two-dimensional CdSe/CdS core@shell dot-in-hexagonal platelet nanoheterostructures with interesting optical properties

Himani Chauhan, Yogesh Kumar, Sasanka Deka*

Department of Chemistry, University of Delhi, North campus, Delhi-110007, India

Email: sdeka@chemistry.du.ac.in; ssdeka@gmail.com

Transmission Electron Microscopy (TEM): Low resolution TEM images, phase-contrast high-resolution TEM (HRTEM) measurements, energy dispersive spectrometry (EDAX), dark-filed TEM imaging and scanning transmission electron microscopy (STEM) analyses were performed with a Philips Technai $G^2$30 aberration corrected transmission electron microscope operating at an accelerating voltage of 300 kV. Samples suitable for TEM observation were prepared by applying one drop of dilute colloidal nanocrystal dispersion in toluene onto the carbon coated Cu grid and allowing the solvent to slowly evaporate at room temperature.

Powder X-Ray Diffraction (XRD): XRD patterns of the as-synthesized products were collected at room temperature using a Bruker D8 Advance and a Rigaku miniflex-(II) X- ray diffractometer system employing monochromatized Cu Kα radiation (λ = 1.54056 Å) source. Concentrated nanocrystal solutions were spread on top of a glass substrate, after which the sample was allowed to dry and was then measured in reflection geometry. Data were collected at a fixed incident angle of about 1°.

UV-Vis Absorption, Photoluminescence (PL) and Photoluminescence Excitation (PLE) Spectroscopy. Absorption measurements were carried out using a Perkin Elmer Lamda 35 UV-Vis spectrophotometer. PL spectra were recorded on a Varian Cary Eclipse fluorescence spectrophotometer with an intense Xenon flash lamp. PLE spectra were also recorded on the Varian Cary Eclipse fluorescence spectrophotometer keeping emission wavelength (λ_{em}) at 565 nm and 621 nm for the CdSe core and CdSe/CdS core shell, respectively.

Time-Resolved Photoluminescence (TRPL). TRPL study was carried out at room temperature by using Horiba Jobin Yvon Fluoro Hub, single photon counting controller having Nano LED of 460 nm with peak wavelength 458 nm and pulse duration of 1.3ns. Band edge PL lifetime was examined by monitoring time resolved fluorescence spectroscopy (TRFS). Time decay spectra obtained on exciting NPs at λ_{ex} = 460 nm.

Determination of CdSe Q.D. seed concentration. The concentration of the CdSe seeds was determined following a method described in literature.[3] First, the quantitative aliquots (100 µL) of the NCs dispersion in oleylamine were taken in quartz cuvette (path length 1 cm) and the final volume made to 3.0 mL by adding 2.9 mL of oleylamine. Next, the absorbance of these nanocrystals oleylamine dispersion was measured by using UV-Vis spectrophotometer. Finally, the concentrations of these CdSe seeds were calculated by using the Beer-Lambert law taking the dilution factor into consideration. The molar extinction coefficients of CdSe were obtained from the literature.[4]

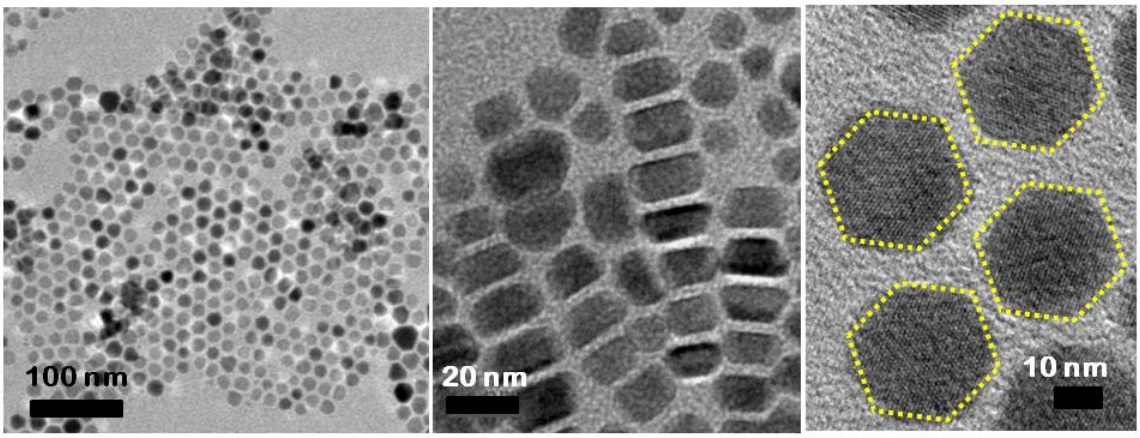

Fig. S1. Additional TEM and HRTEM images of CdSe/CdS core@shell 2D nanoheterostructure samples. The left panel is for low magnification image, middle panel for self-assembled particles lying on the edges and the right panel for HRTEM image.

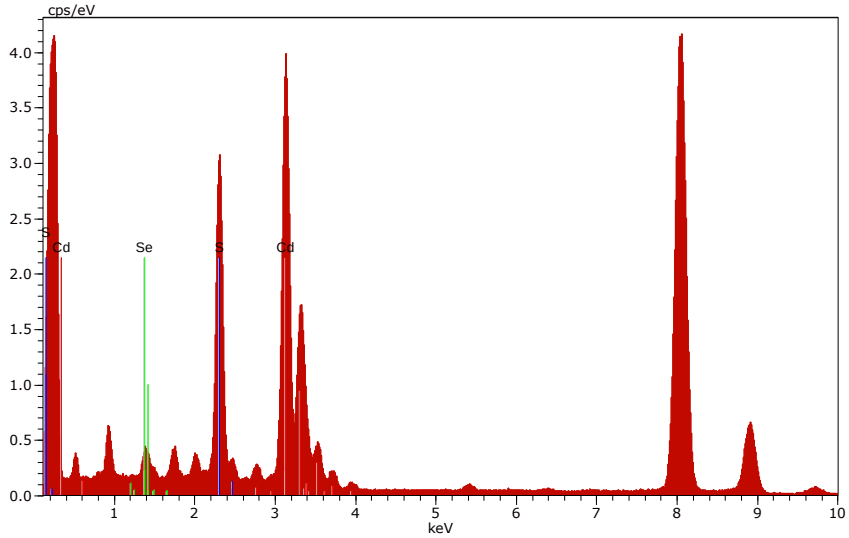

Fig. S2. EDAX of core@Shell from CdSe-A showing the presence of Cd, Se and S.

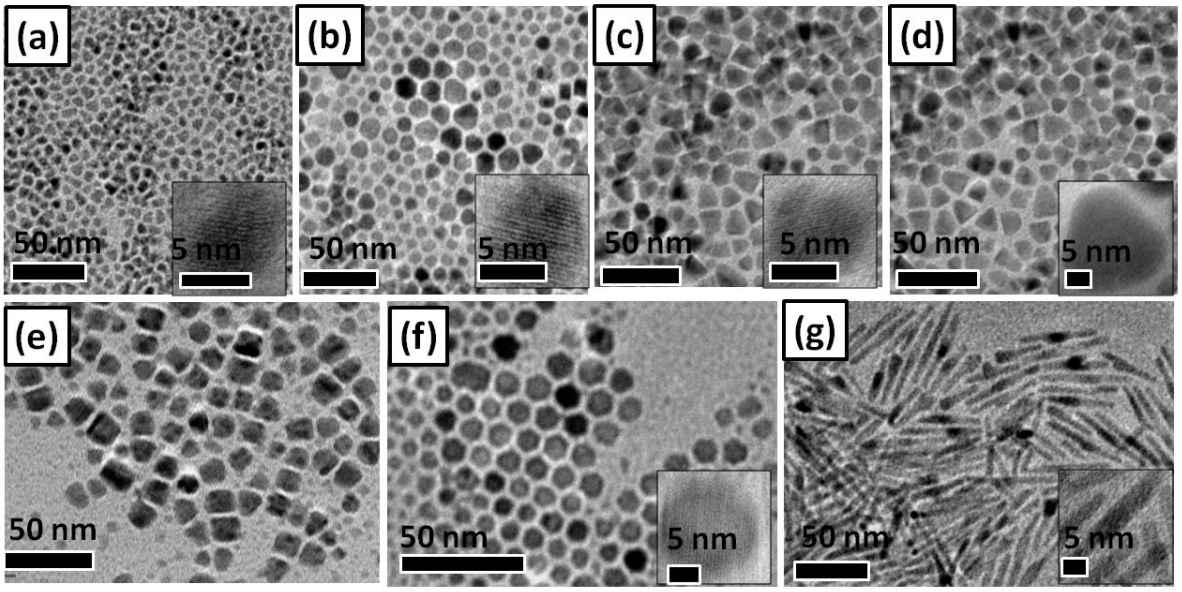

Fig. S3. Control reaction TEM images from table 1. Here panel (a) corresponds to reaction serial No 1, (b) to 2, (c) to 3, (d) to no CdO, (e) to no CdSe core, (f) to No S and (g) corresponds to reaction 7 for nanorods, respectively.

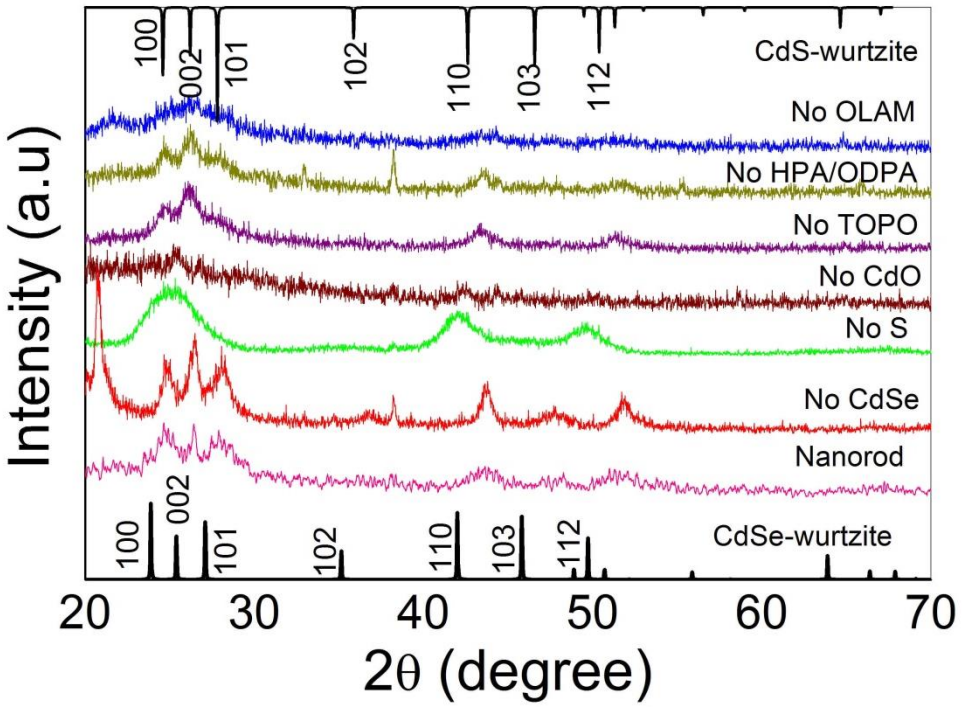

Fig. S4. Powder XRD patterns of the products from Table 1 in manuscript. All patterns are labelled according to Table 1.

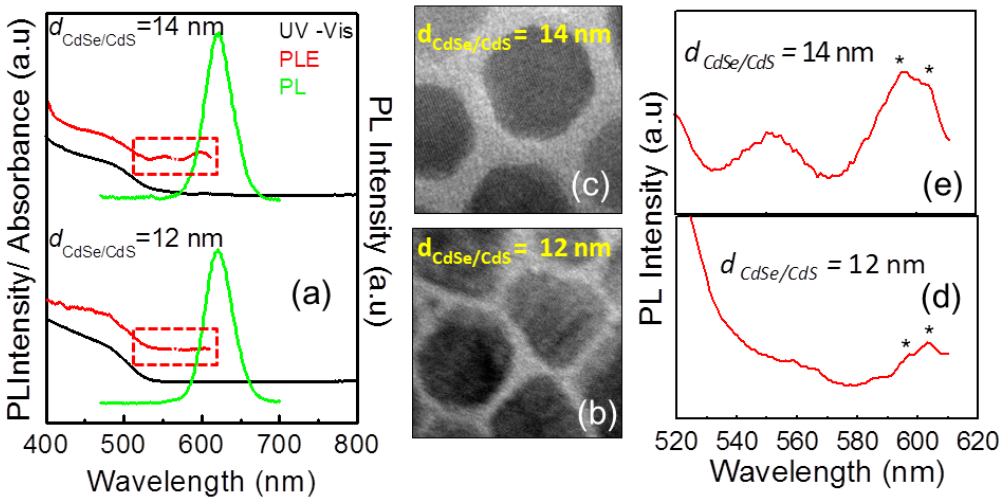

Fig. S5. Comparison of optical absorption, PLE and PL spectra of 2D CdSe/CdS nanoheterostructures with increasing shell size (growth). (a) UV-Vis, PLE, PL of two CdSe/CdS core/shell samples (b,c) TEM images of the corresponding samples. (d,e) Magnified PLE spectra in the range 520-620 nm, taken from the selected area in panel 'a'.

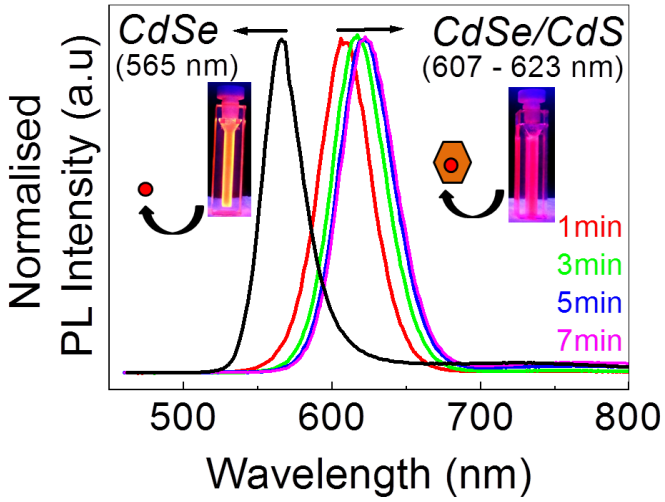

Fig. S6. Red shifting of the PL peak of the 2D core/shell NCs with growth time with respect to the starting CdSe core.

Reference:

1. A. Peng and X. Peng *J. Am. Chem. Soc.* **2001,** *123,* 183-184
2. L. Carbone, C. Nobile, M. D.Giorgi, F. D. Sala, G.Morello, P.Pompa, M.Hytch, E.Snoeck, A. Fiore, I. R. Franchini, M.Nadasan, A. F. Silvestre, L.Chiodo, S.Kudera, R.Cingolani, R.Krahne, and L. Manna *NanoLett.***2007**, *7*, 2942– 2950
3. Y. A. Yang, H. Wu, K. R. Williams, and Y. Charles Cao *Angew. Chemie Int. Ed.***2005**, *44*, 6712–6715.
4. W. W. Yu, L. Qu, W. Guo, and X. Peng, *Chem. Mater.***2003**, *15*, 2854