Supporting information

Two-Dimensional Arrays of Luminescent Metal-Selenide Nanoparticle

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Experimental Section

Fabrication of Nanostructures by Micellar Approach: An asymmetric block copolymer PS-*b*-P4VP was purchased from Polymer Source, with polydispersity index of 1.14 and the number-average molecular weights of PS and PVP being 47 600 and 20 900 g/mol, respectively. In a typical procedure, 0.5 wt % micellar solutions was prepared by dissolving the PS-P4VP block copolymer in toluene at room temperature with stirring for 3 h. $CdCl_2$ as a precursor of CdSe nanoparticles was added to the micellar toluene solution (molar ratio of $CdCl_2$/vinyl pyridine = 1.0, 20) and stirred for at least 24 h. Then the solution was filtered through a syringe and layered on top of the freshly prepared NaHSe[26] (0.2 mol) aqueous solution under inert atmosphere. The heterogeneous solution mixture was further stirred for more than 24 hr at room temperature. Then the top toluene layer containing PSP4VP-CdSe micelles was carefully removed from aqueous solution by a syringe. All characterizations were carried out after keeping the micellar toluene solution containing CdSe nanoparticles for more than seven days at room temperature. It is worth noting that the excess addition of $CdCl_2$ while loading produces crystalline nanoparticles inside the core of the micelles. By using a similar approach, ZnSe and PbSe nanoparticles are also prepared inside the micelle core.

Monolayer thin films were fabricated by spin coating at 4000 rpm on a cleaned silicon wafer. To remove the polymer matrix, the monolayer films were irradiated by ultraviolet (UV) light of major wavelength ~254 nm with a dose of 25 J/cm2 (XX-15S; UVP, Inc) at room temperature for 48 h in air.

HR-TEM images and EDX spectrum were acquired on a JEOL JEM-2100F field emission-TEM and Oxford Inst, INCA operated at 200 kV. The samples were prepared by directly dipping the TEM grid into micellar solution. For powder X-ray diffraction, the sample was prepared by solution casting of the composite film on the cleaned silicon wafer. Powder X-ray diffraction measurements were taken on a RIGAKU D-MAX1400.

UV-VIS spectra were obtained by using Carry 5000 UV-vis-near infrared double beam spectrophotometer. Photoluminescence (PL) spectra were collected with a Horiba Jobin Yvon Fluorolog fluorometer.

The nanostructure of the block copolymer template film was characterized by scanning probe microscopy (SPM) with tapping mode (Nanoscope IIIa, Digital Instruments/Veeco) (and FE-SEM (Hitachi, S-4800, operated at 5 kV). The tip used for SPM was POINTPROBE, Silicon SPM Sensor (thickness 4 μm, length 125 μm, width 30 μm and tip radius 10-15 nm). The height of the CdSe nanoparticles was obtained by cross-sectional analysis of SPM height image (Figure S3). We have taken into account of more than 100 nanoparticles for obtaining the average height of nanoparticles. To make sure the reproducibility and uniformity, more than 10 SPM images were taken from different samples and at different places of single sample.

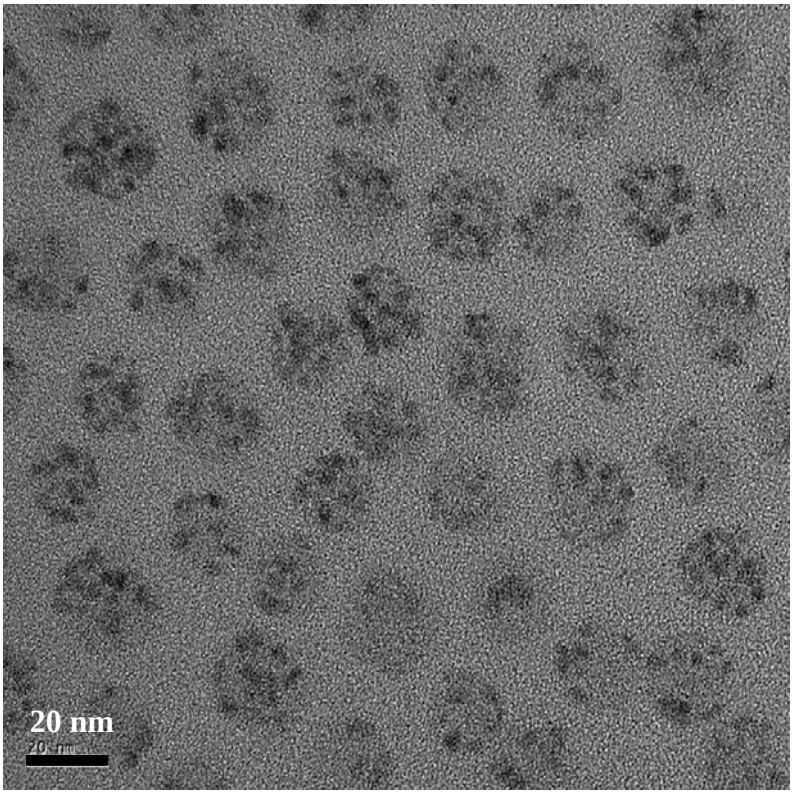

Figure S1. TEM image of PS-P4VP-CdSe-2 at a higher magnification, which clearly shows multiple nanoparticle formation in a single core of the micelles.

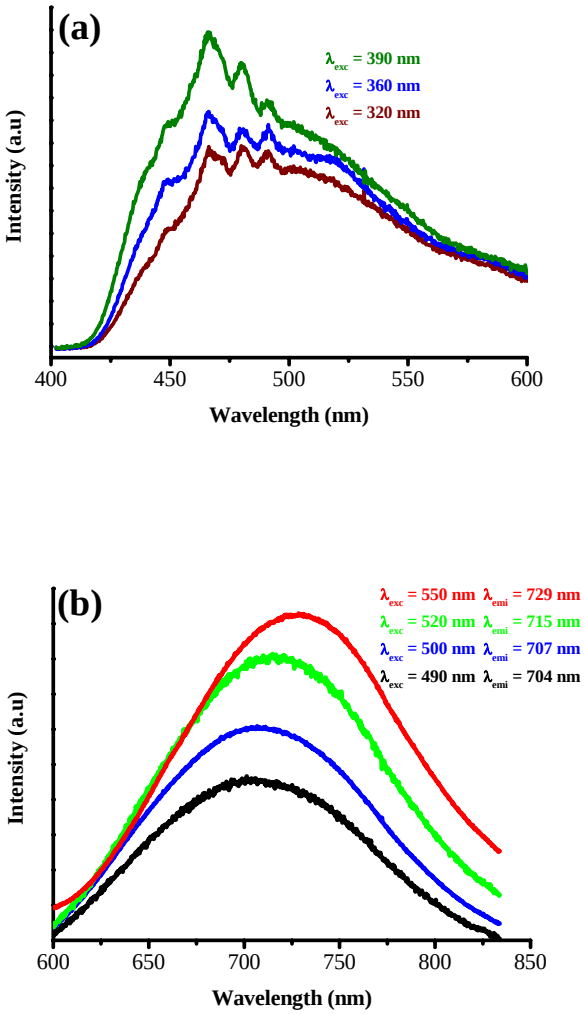

Figure S2. Photoluminescence spectra of PS-P4VP-CdSe-1 (a) and PS-P4VP-CdSe-2 (b).

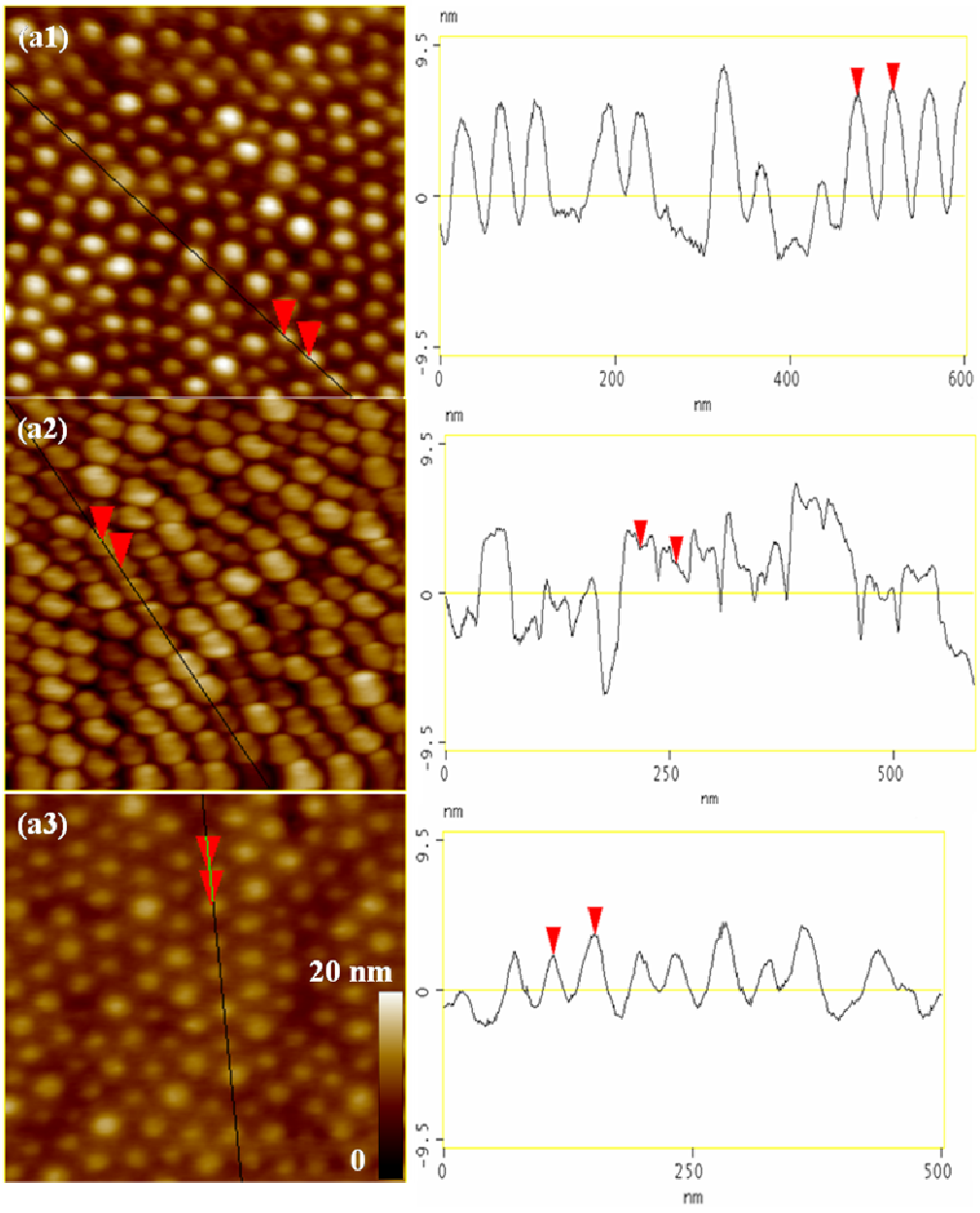

Figure S3(a). SPM height and cross-sectional images of as fabricated monolayer (1), polymer matrix removed by UV exposure (2) and annealed (3) CdSe two-dimensional nanoparticle arrays fabricated from PS-P4VP-CdSe1.

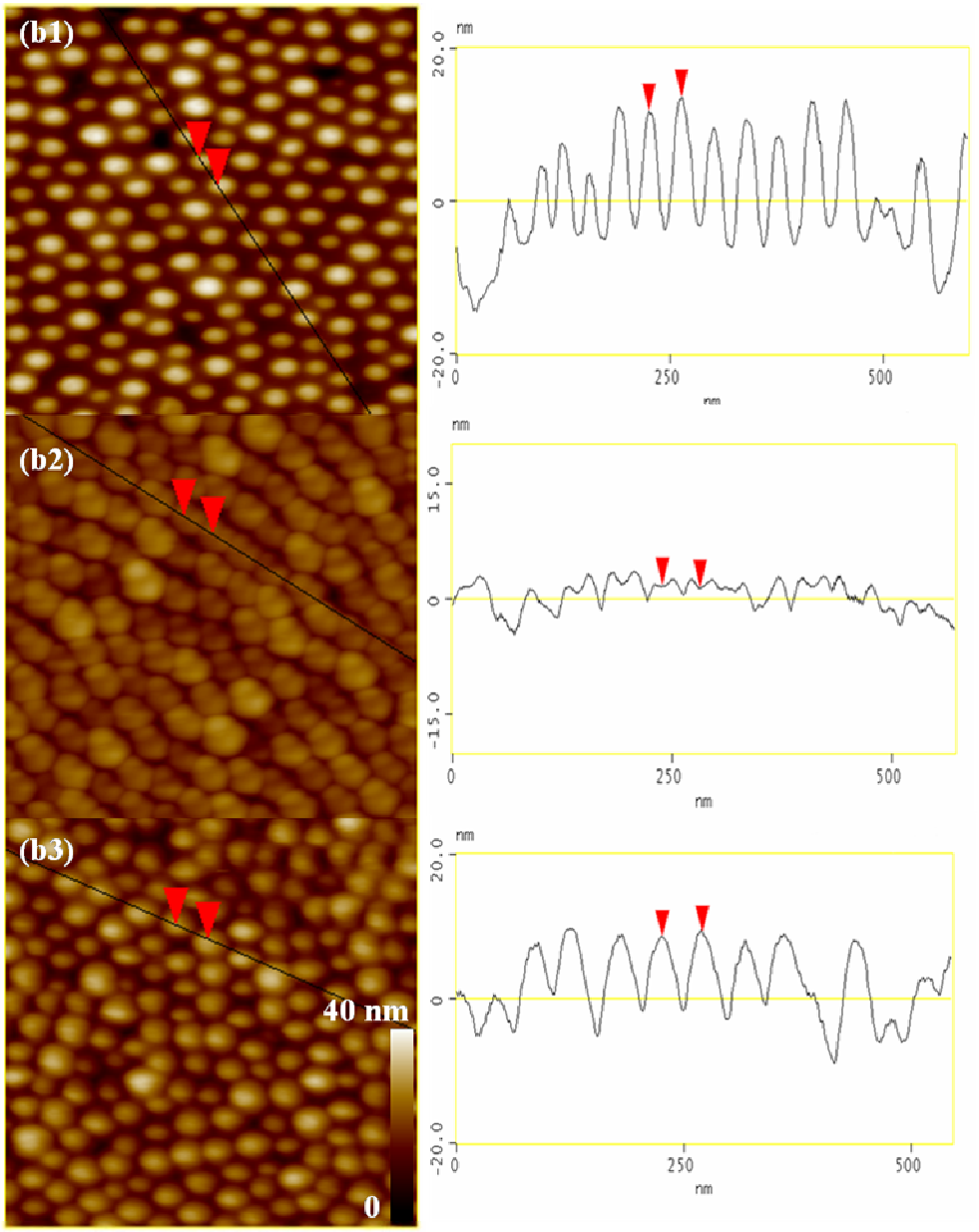

Figure S3(b): SPM height and cross-sectional images of as fabricated monolayer (1), polymer matrix removed by UV exposure (2) and annealed (3) CdSe two-dimensional nanoparticle arrays fabricated from PS-P4VP-CdSe-2.

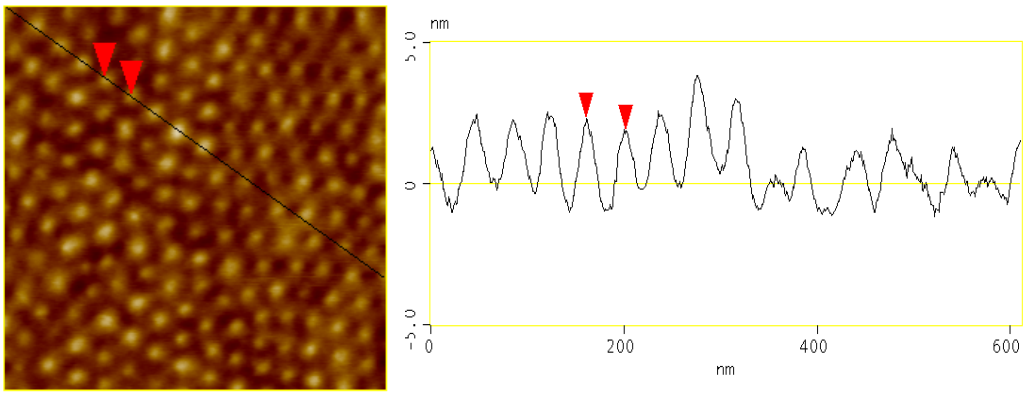

Figure S4: SPM height and cross-sectional image of neat PS-P4VP monolayer film.

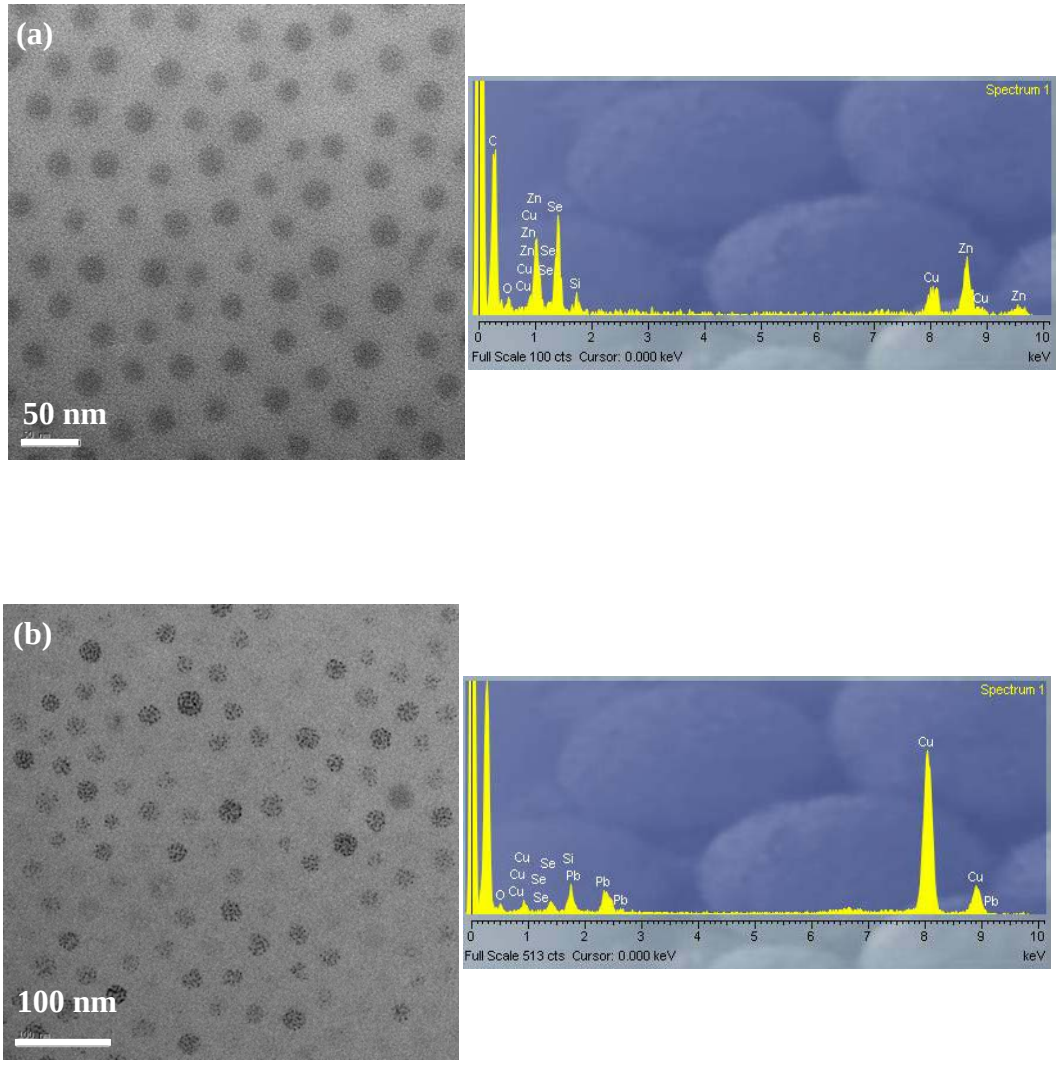

Figure S5. HR-TEM images and EDX spectra of (a) ZnSe and (b) PbSe nanoparticles prepared inside the micelles core, which also shows the formation of metal-selenide nanoparticles only at the core of the micelles.