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Supporting Information

A two-step Method to Synthesize Water-Soluble Mn:ZnSe/ZnO Core/Shell Quantum Dots with Pure Dopant Emission

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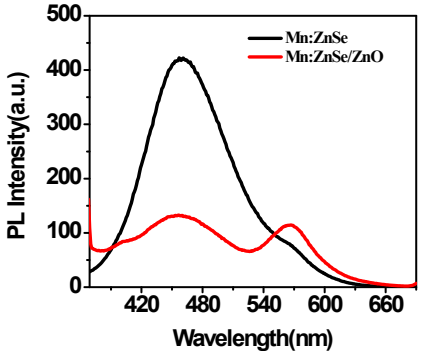

Fig.S1 PL spectra of Mn:ZnSe before and after ZnO shell growth. The QDs were prepared using nucleation-doping strategy via aqueous synthesis method.

Mn:ZnSe cores directly synthesized in aqueous solution through nucleation-doping strategy, based on previous report[1-2], have strong trap emission beside Mn dopant emission, showing in Fig. S1. After growth of ZnO shell, the trap emission can not

disappear. A possible reason is the a large amount of irradiative defects inside the Mn:ZnSe cores. In comparison, the current two-step method can prepare Mn:ZnSe cores with less defects inside the cores, making improved monochromaticity.

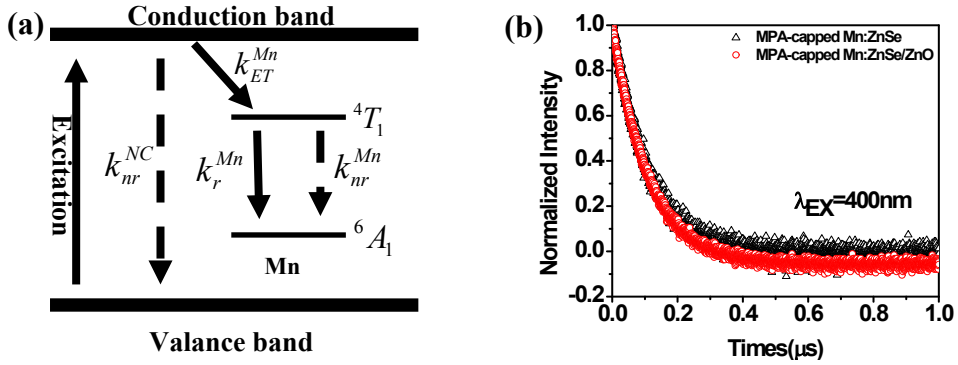

Fig.S2 (a) Energy level diagram for the Mn:ZnSe nanocrystals (NCs). (k_r and k_{nr} stand for linear decay rates for radiative and nonradiative processes. k_{ET} stands for the rate of energy transfer.) (b) Time-resolved PL spectra of Mn:ZnSe cores before and after ZnO shell growth, respectively.

PL lifetimes was measured with Femtosecond Laser as excitation resource and oscilloscope as signal receiver. The excitation wavelength was 400nm. We adopt single exponential fitting formula (1) to calculate PL lifetime.

$$I_t = I_0 e^{-kt} + b \qquad (1)$$

Where I_0 is the largest fluorescence intensity when excited, I_t is the the fluorescence corresponding to the time t, k is attenuation index, b is constant. When $I_t = 1/e \cdot I_0$, the relevant time t is the fluorescent lifetime.

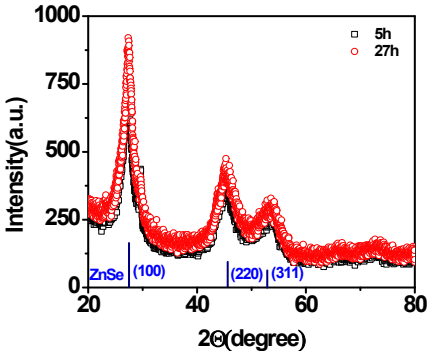

Fig.S3 XRD patterns of OA-capped Mn:ZnSe cores stored in air (with light and oxygen at the same time) for 5h and 27h, respectively.There was no obvious shift of the three diffraction peaks for these two samples.

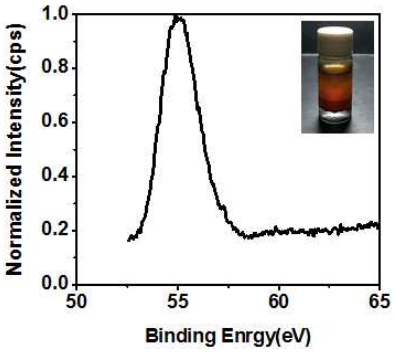

Fig.S4 XPS pattern of Se in the oleic acid-capped Mn:ZnSe cores after stored in open air. The inset is the picture of oleic acid-capped Mn:ZnSe cores. As can be seen, there are a large amount of insoluble precipitates at the bottom of the flask.

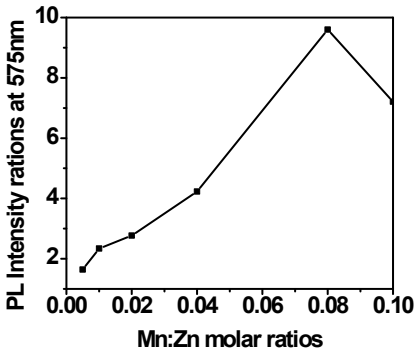

Fig.S5 PL Intensity rations at 575nm of Mn:ZnSe before and after surface overcoating as a function of Mn/Zn molar ratios. Zn corresponds to Zn stock solution for core.

Table S1 Components ratios of OA-capped Mn:ZnSe, MPA-capped Mn:ZnSe and MPA-capped Mn:ZnSe/ZnO core/shell QDs measured by ICP-MS.

	Molar Ratios	
	Mn	Zn
feed rario	1	12.5
ICP-Mn:ZnSe	1	14.1
ICP-Mn:ZnSe/ZnO	1	41.3

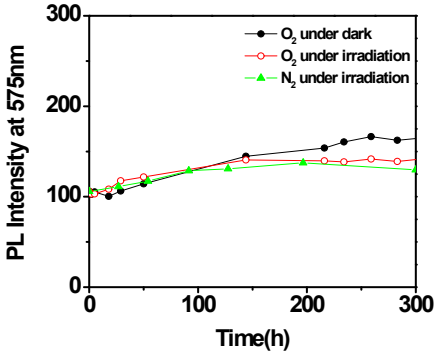

Fig.S6 PL intensity at 575nm of Mn:ZnSe/ZnO QDs as a function of storage time under O_2 or N_2 and with or without sunlight irradiation.

As shown in Fig.S6, in the initial stage during storage, the PL intensity of Mn:ZnSe/ZnO QDs slightly increased due to the diminution of defects[3]. Afterward, no matter in what kind of conditions, the PL intensity almost keep the same. It demonstrated that the formation of core-shell structure improved the photochemical stability of the Mn:ZnSe/ZnO QDs[4].

References

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