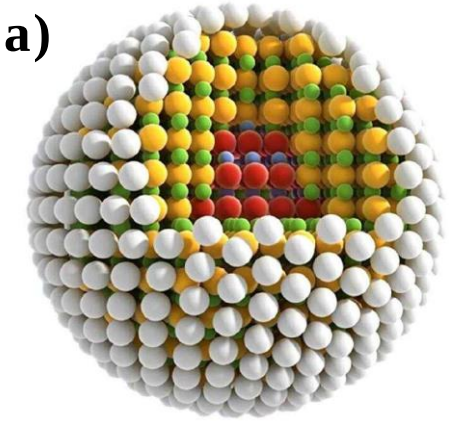
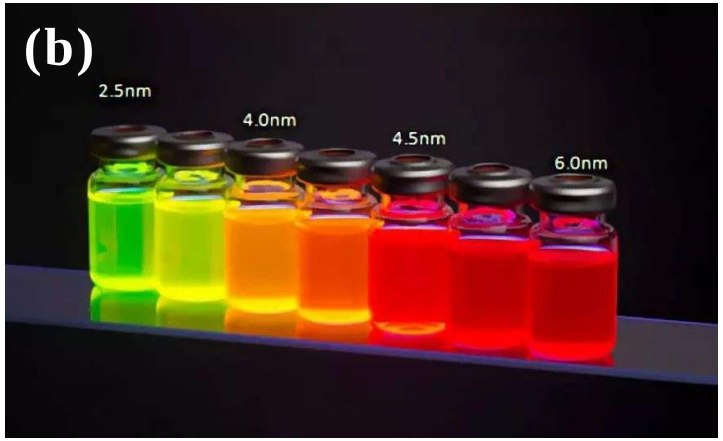
Introduction to Quantum Dots

Quantum dots (QDs) are semiconductor particles a few nanometres in size, having optical and electronic properties that differ from those of larger particles as a result of quantum mechanics.

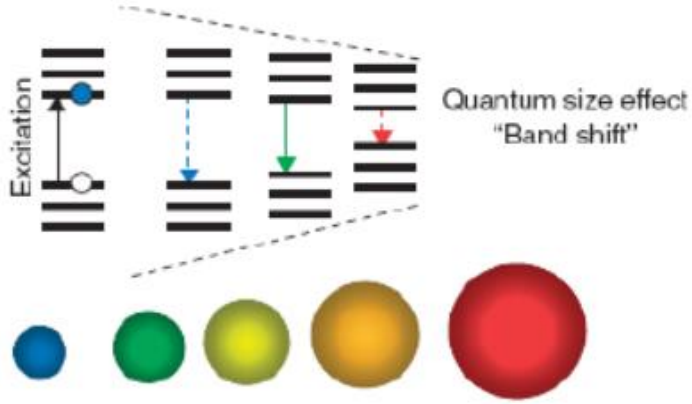
(a)



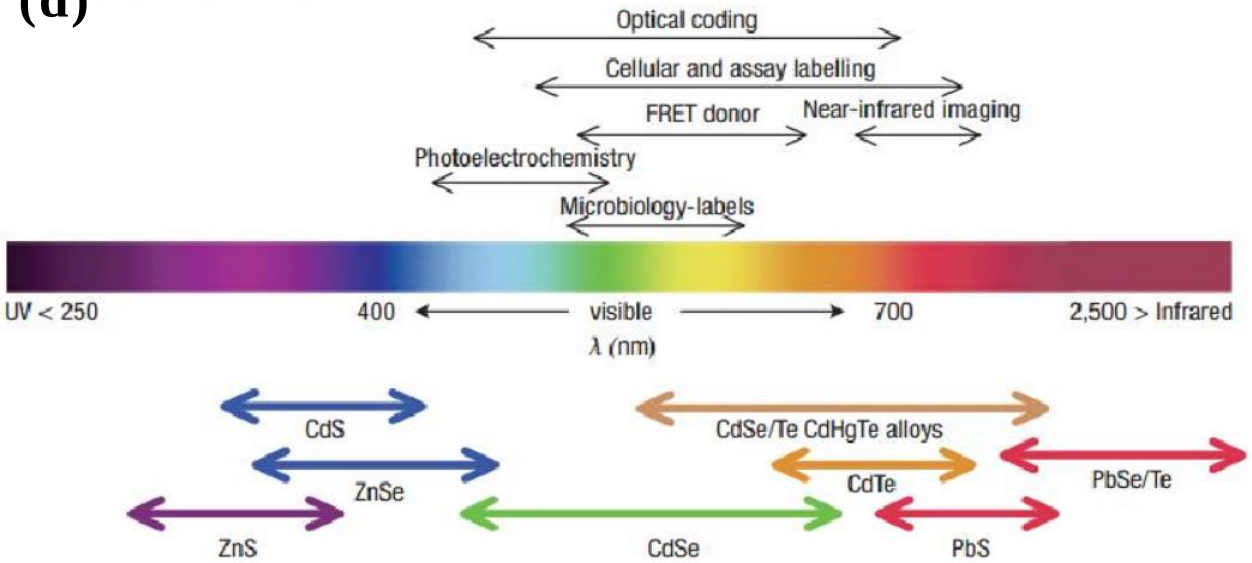
(b)

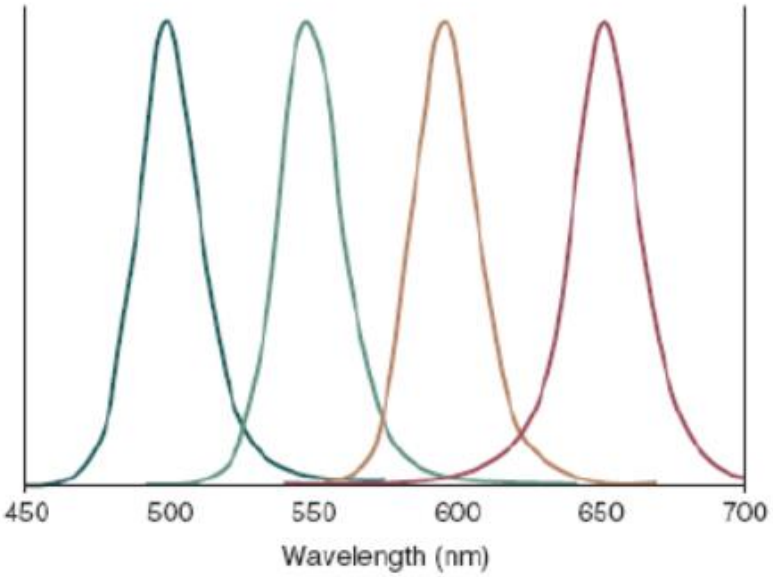


(c)



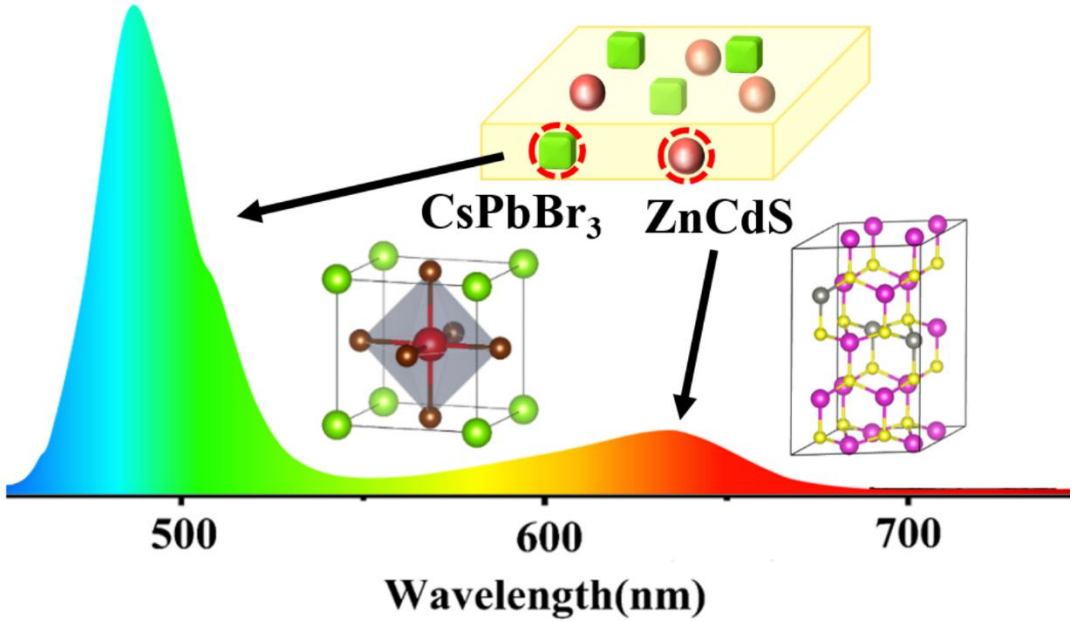
(d)

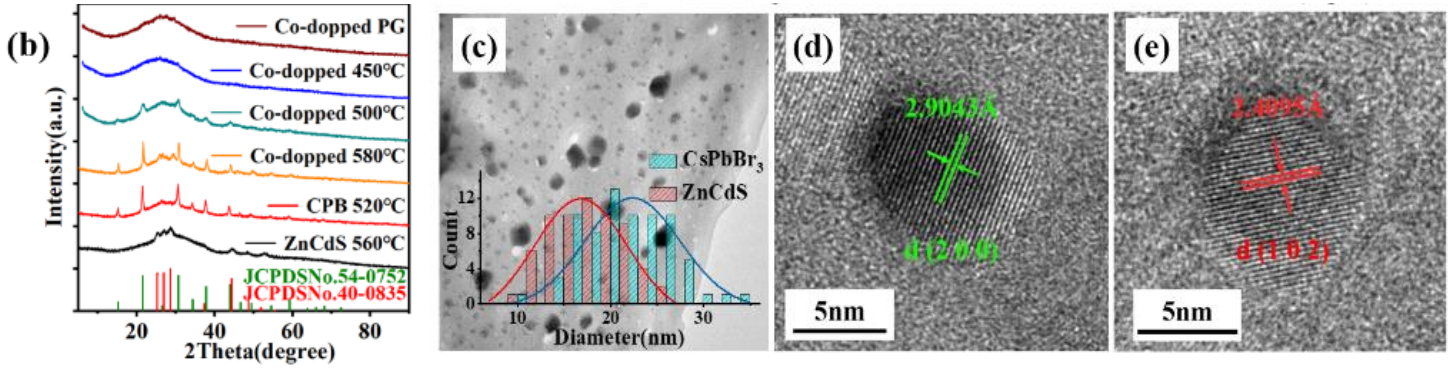


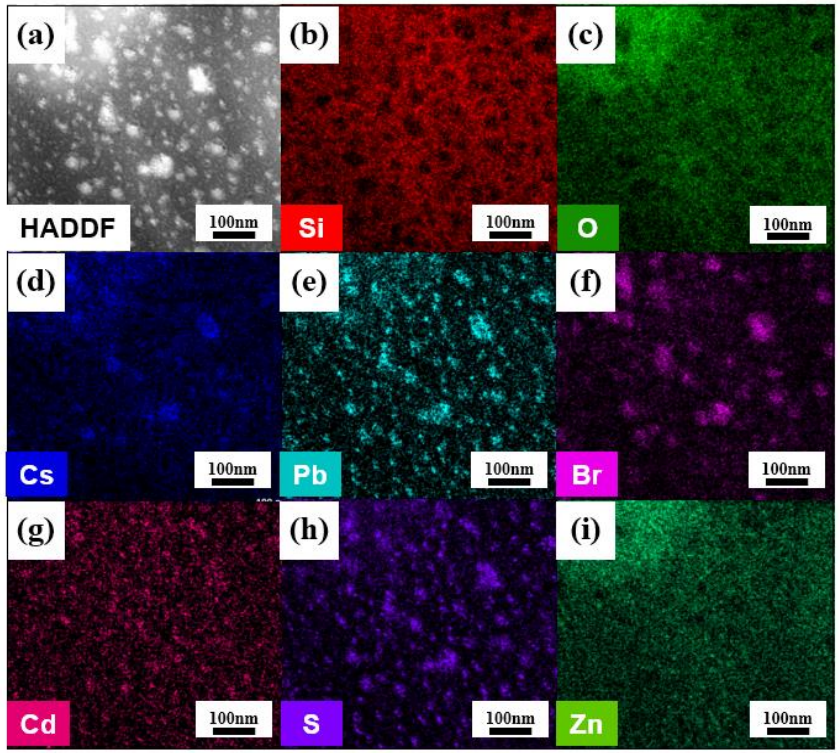


Structural characterization

Both $CsPbBr_3$ and Zn-Cd-S quantum dots are precipitated in the glass, and the distribution is uniform.

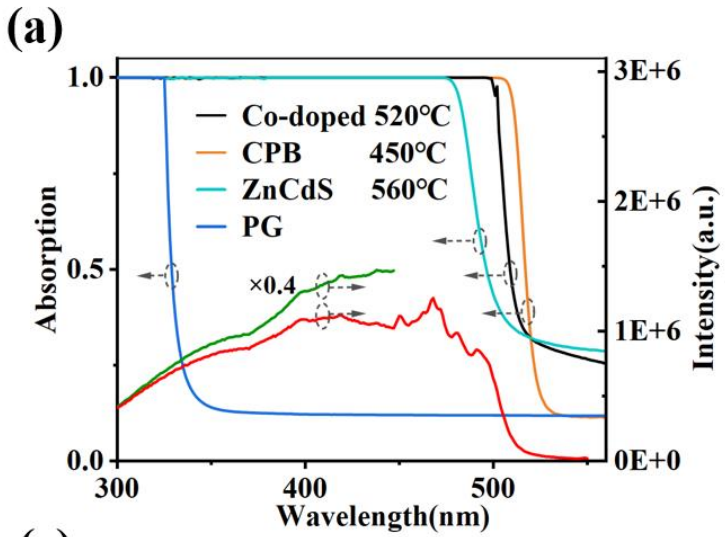


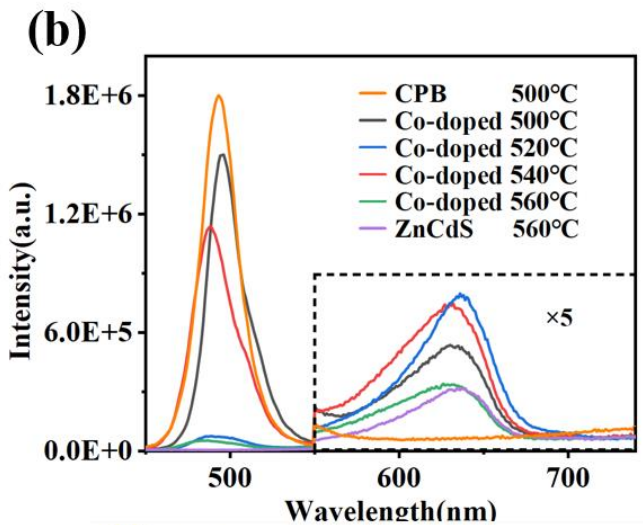


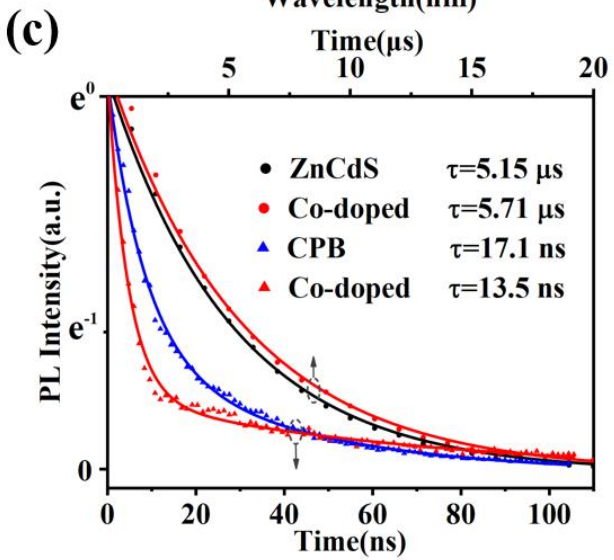


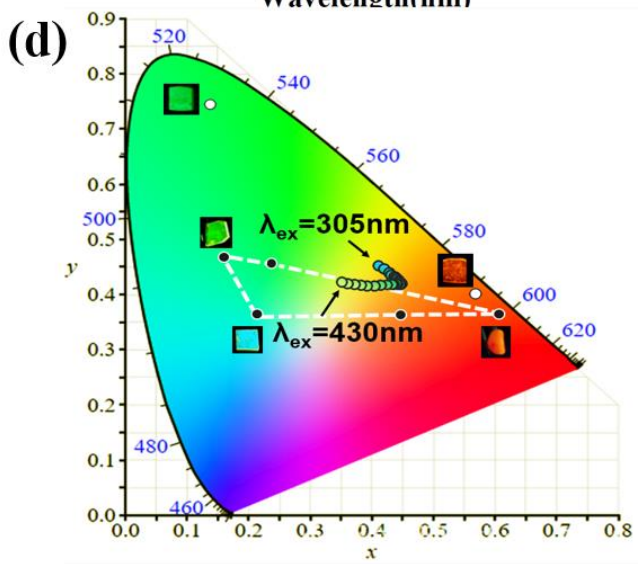
The average grain size is 20nm and 15nm, respectively, and the crystallization rate is 4.92% and 1.29%.

Photoluminescence (PL)







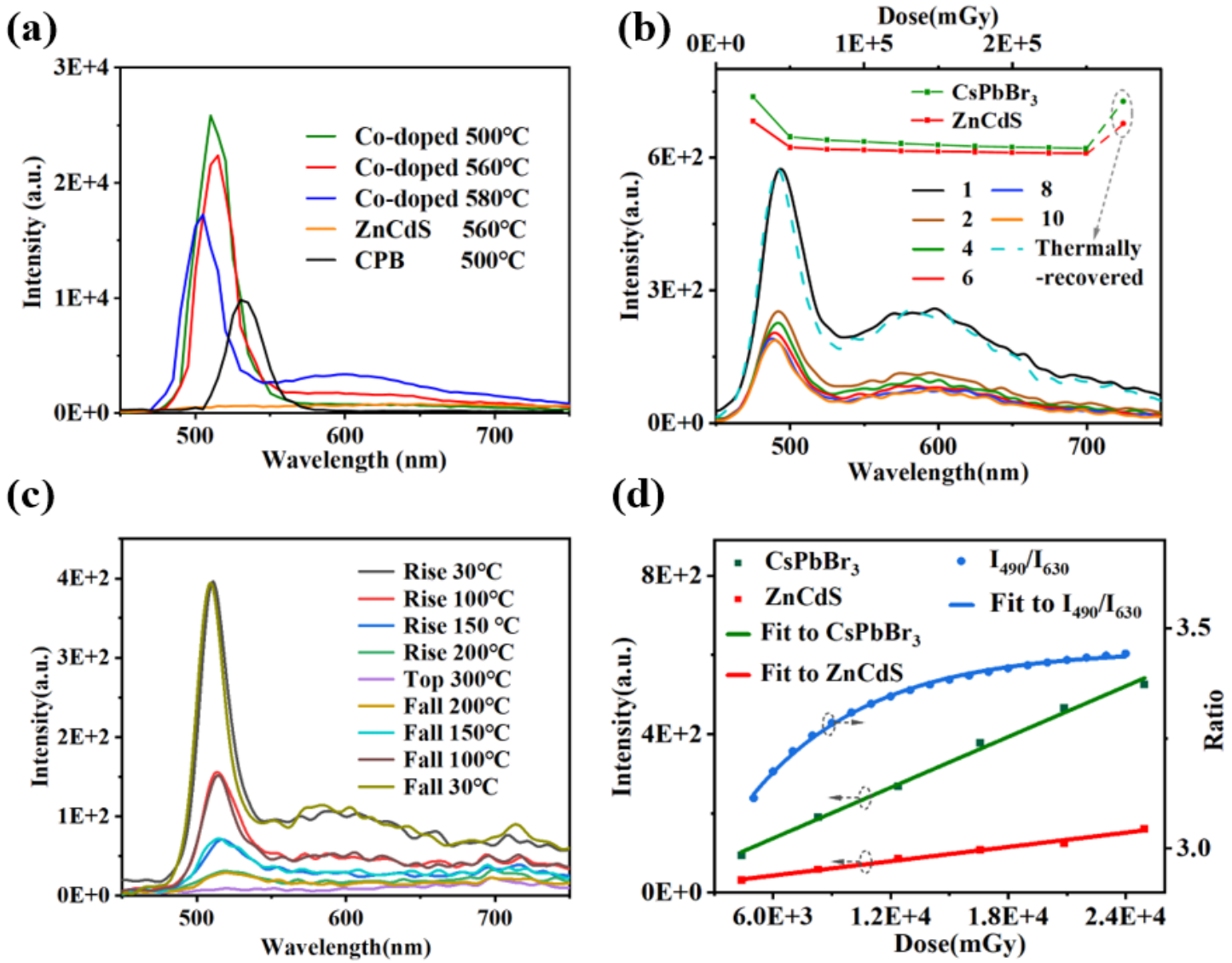


Continuously adjustable emission peak

1. the thermal heating scheme—widely adjusted
2. the excitation wavelength—fine-tuned

Sample	QDs	λ(nm)	τ
Co-doped	$CsPbBr_3$	488	13.9ns
CPB	$CsPbBr_3$	493	17.2ns
Co-doped	Zn-Cd-S	626	5.71μs
ZnCdS	Zn-Cd-S	634	5.15μs

X-rays excited radioluminescence (XEL)



The tunable dual-band emissions can be also achieved under the X-rays excitation.

Radiation damage can be reduced by heating

Good thermal stability

Bimodal peak ratio

The sensitivity of exponential fitting is higher

Conclusions

- The $CsPbBr_3$ and Zn-Cd-S QDs can be simultaneously grown in borosilicate glass
- When excited, these exists an ET between the biphasic QDs due to reabsorption or direct exciton exchange.
- Owing to the different volume fraction or pump-energy harvesting ability of the biphasic QDs, the green to red emission ratio and thus the apparent color can be broadly adjusted.
- The tunable dual-band emissions can be also achieved under the X-rays excitation.
- Although the XEL weakening occurs possibly due to the X-rays induced photodegradation or defects, such adverse effect can be readily wiped off by post-thermal-annealing.
- A self-calibrated X-rays dosimeter with a good thermal stability is constructed on the fluorescence intensity ratio of the unique dual-band emissions.