

# Thermal Stable Quantum Rod for Efficient On-chip WLED by Reducing Reabsorption Loss

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## Abstract

Large coupling efficiency, thermal stability, high efficiency, and saturated colors are essential properties for solid-state lighting and vivid displays. Quantum rods (QRs) are semiconductor nanoparticles with an elongated shape that possess superior properties such as larger effective Stokes shifts<sup>[1]</sup>, extinction coefficients, higher QY<sup>[2]</sup>, and high outcoupling efficiency in solid films<sup>[3]</sup>. In this work, we show an environmentally friendly gradient alloyed CdSe/ZnXCd<sub>1-X</sub>S/ZnS and CdSe/CdS/ZnS core-shell QRs with high efficacy, wide color gamut, and thermal/photostable WLED, which are suitable for the direct-lit LCD backlight. The engineered shell thickness suppresses energy transfer and Auger recombination and maintains a high PLQY in the film state (65% for red, 81% for green). A high Luminous efficacy (LE) with the wider color gamut simultaneously is the most compelling part of the display system. There is a fundamental trade-off between luminous efficacy and the color gamut, and therefore, it is a big challenge to achieve high LE and the wider color gamut at the same time. Using QRLEDs, we achieved a high LE (~98 lm/W @10mA), wide color gamut (~118% NTSC in 1931 color space), representing a superior performance in comparison to the state-of-the-art phosphor-based on-chip LEDs, which paves a way to improve the LED backlight efficiency.

## Results

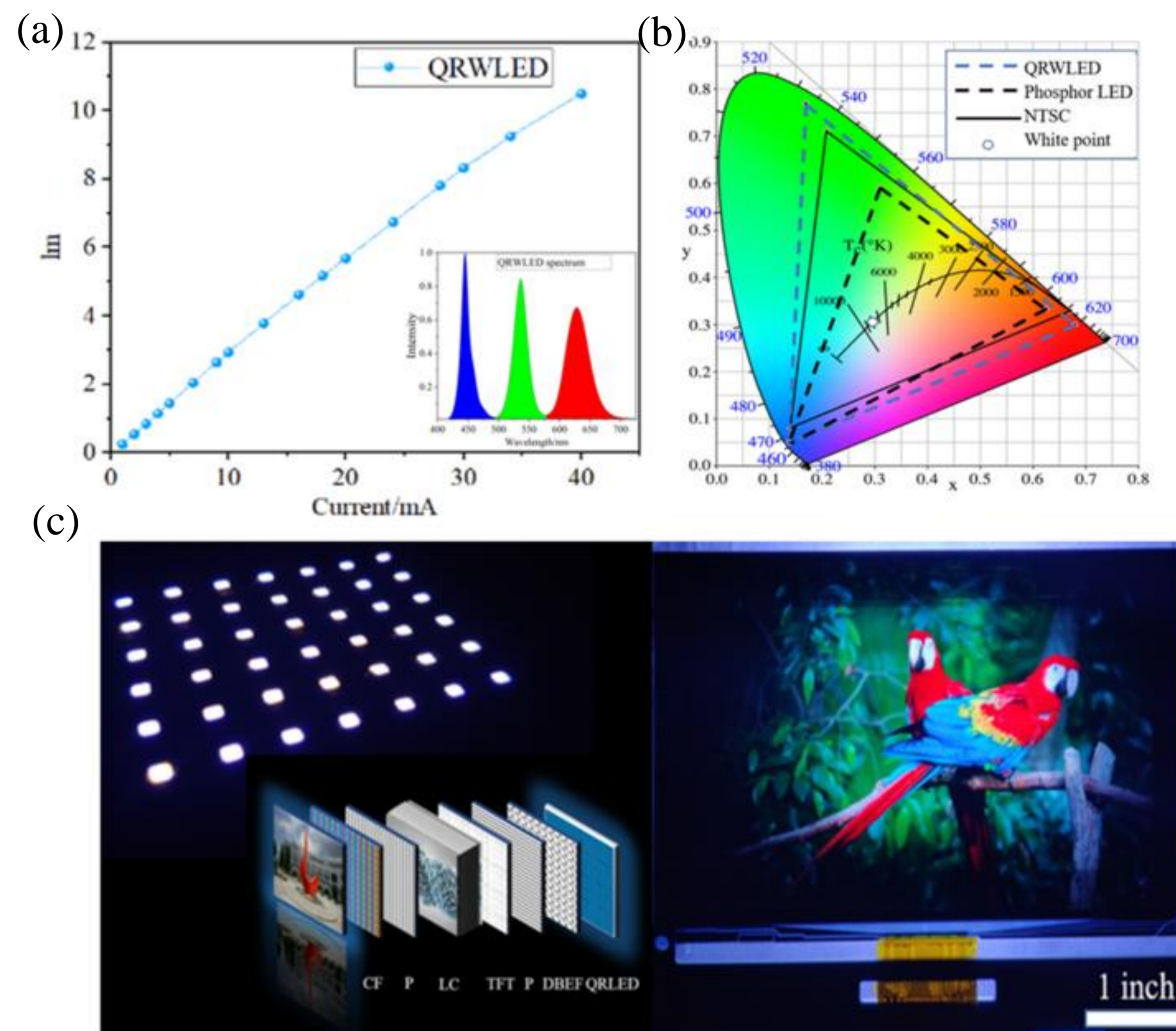
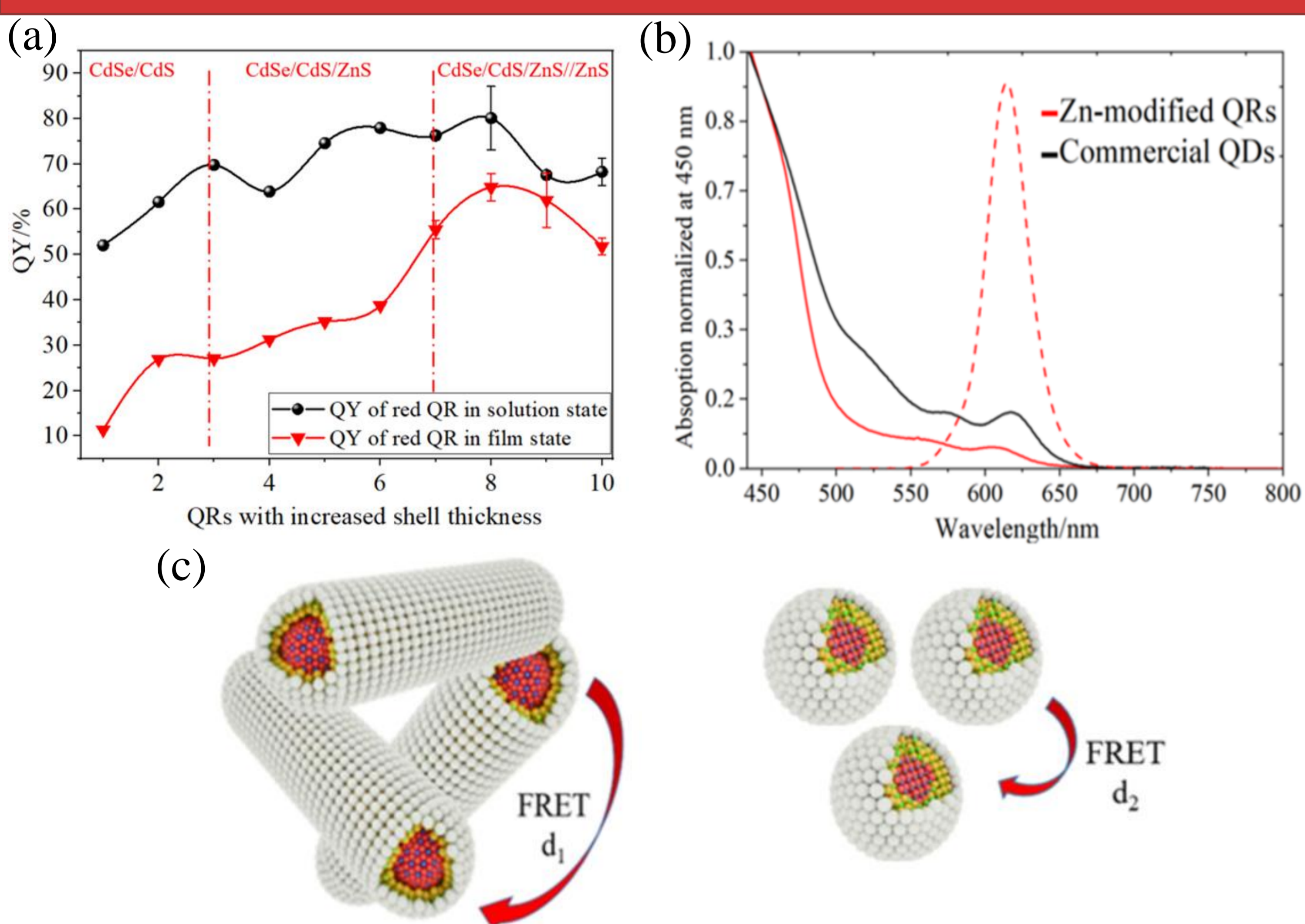


Figure 3: a) SPD of WLED backlight of QRLED. b) Color gamut between phosphor and QR. c) Backlight and QRWLED based display prototype

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## Reference

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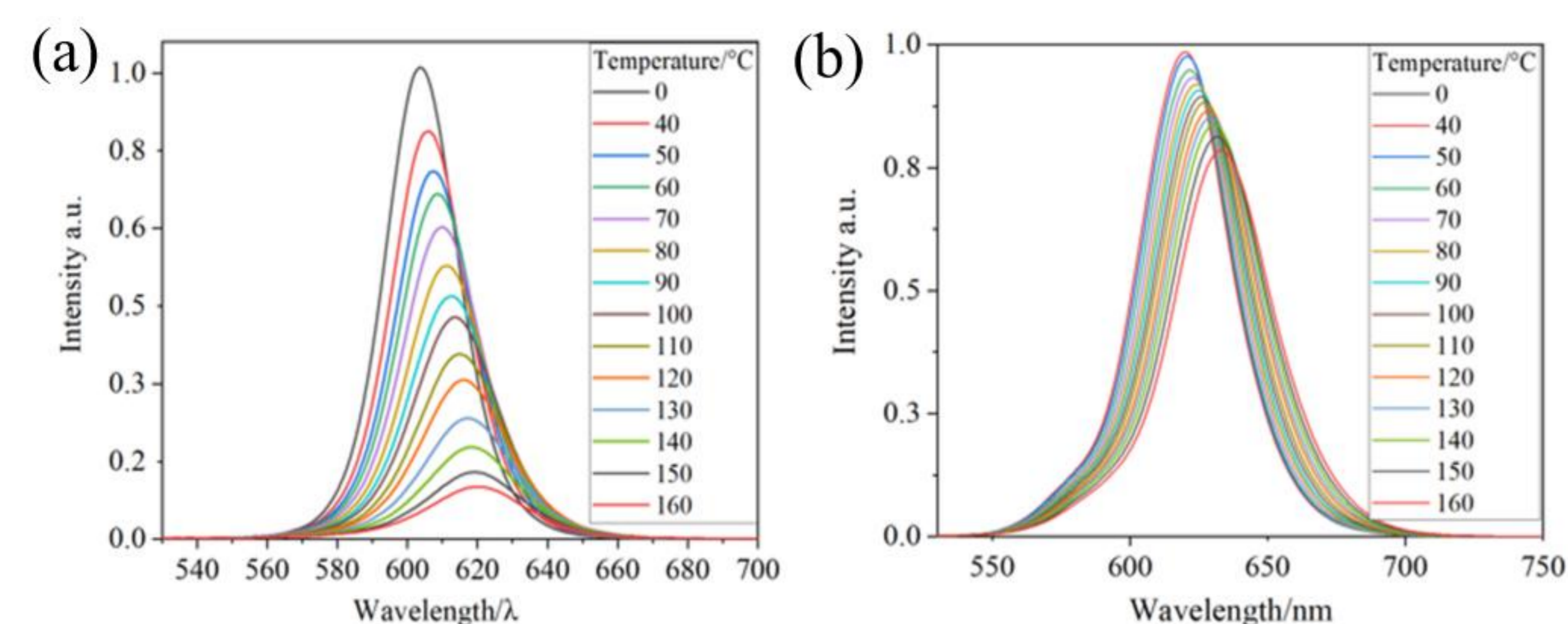


Figure 2: Thermal stability of a) CdSe/CdS and b) CdSe/CdS/ZnS QRs