

Electronic Supplementary Information for

Quantum dot-layer-encapsulated and phenyl-functionalized silica spheres for highly luminous, colour rendering, and stable white light-emitting diodes

*Hyein Yoo, Ho Seong Jang, Kwangyeol Lee, and Kyoungja Woo**

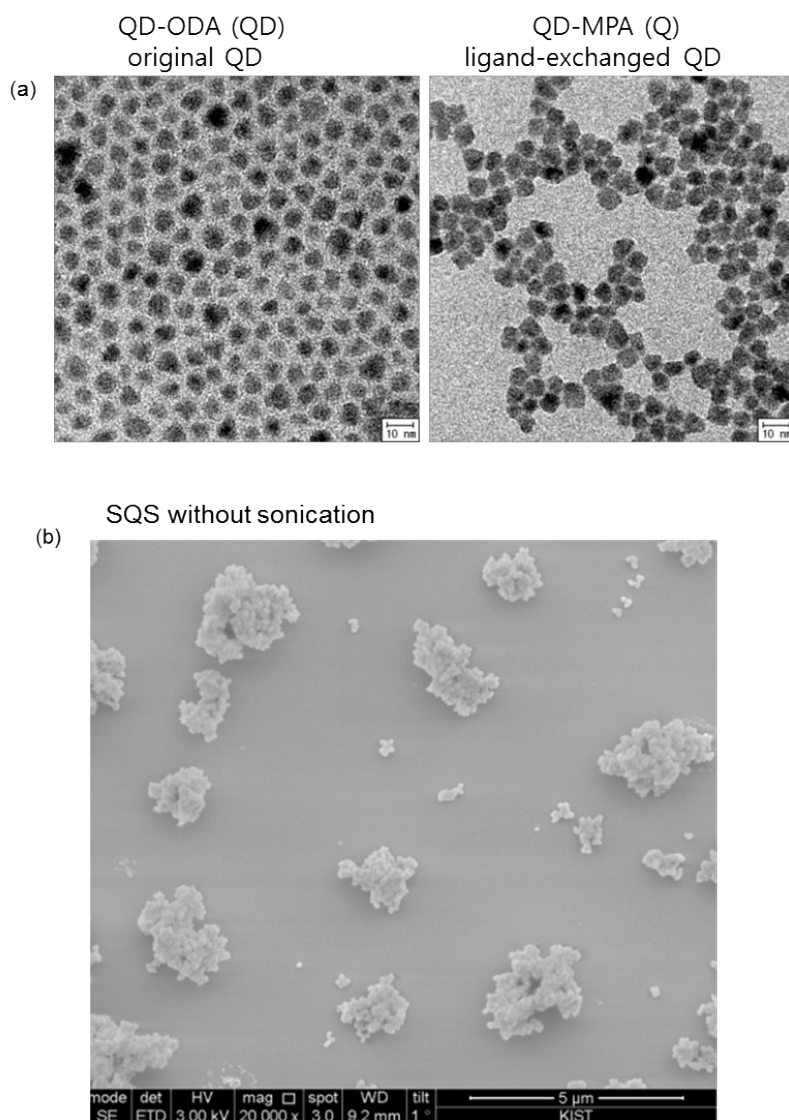


Figure S1. (a) TEM images of QD and Q with $\lambda_{\text{emit}} = 620$ nm, (b) SEM images of SQS prepared without sonication.

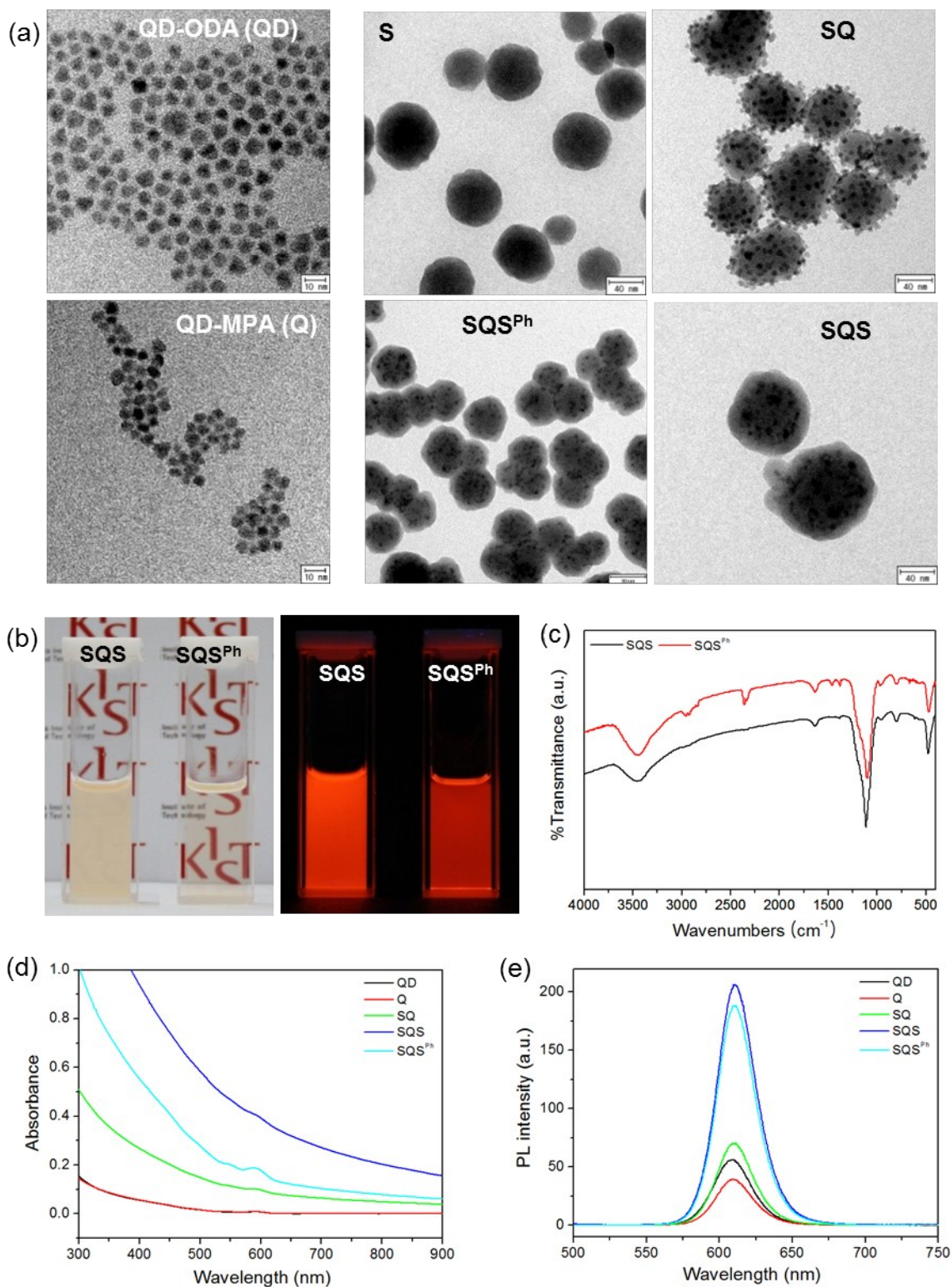


Figure S2. (a) TEM images, (b) photographs, and (c) FT-IR, (d) UV-Vis absorption, and (e) PL spectra of the materials (QD, Q, S, SQ, SQS, and SQS^{Ph} with $\lambda_{\text{emit}} = 611$ nm) corresponding to Scheme 1.

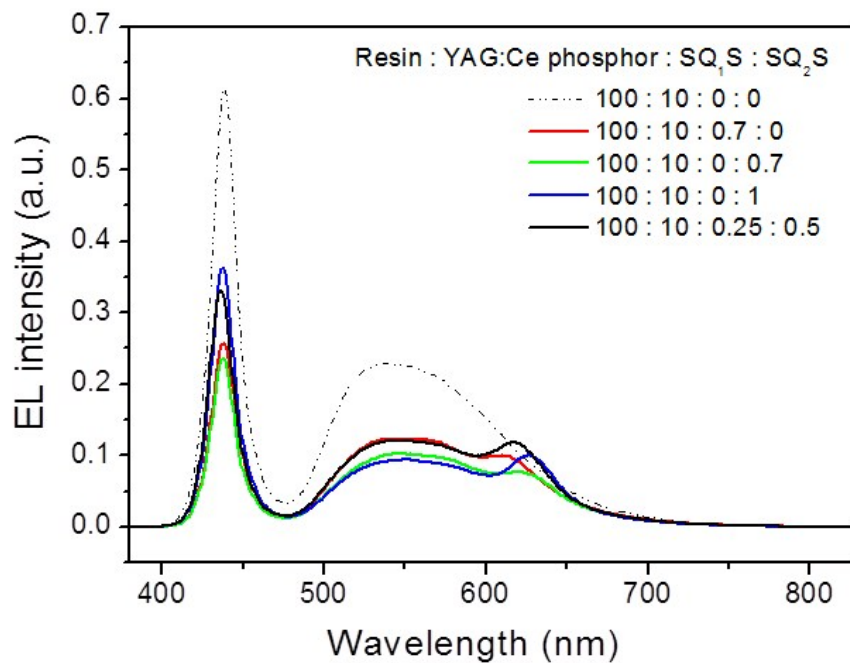


Figure S3. EL spectra of YAG:Ce phosphor- and SQS-based white LEDs with different weight ratios for resin : (YAG:Ce) phosphor : SQ₁S : SQ₂S.

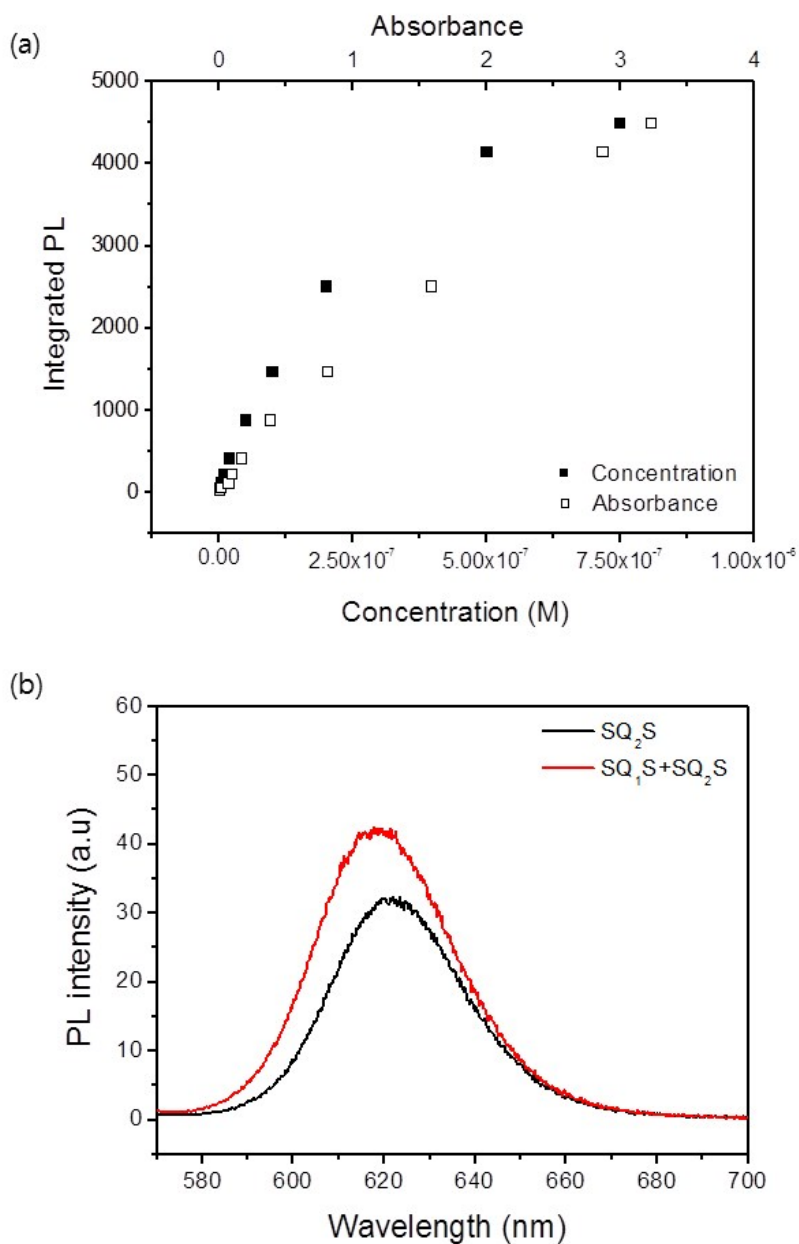


Figure S4. (a) Integrated PL vs. absorbance and QD-based concentration data for SQ_2S and (b) PL spectra of SQ_2S only solution and the mixture solution of SQ_1S and SQ_2S , whereby the total QD-based concentration is 7.0×10^{-8} M in the SQ_2S only solution and 7.5×10^{-8} M in the mixture solution with $SQ_1S : SQ_2S = 1 : 2$, under 550 nm excitation. The integrated PL ratio in (b) is 1 : 1.4.

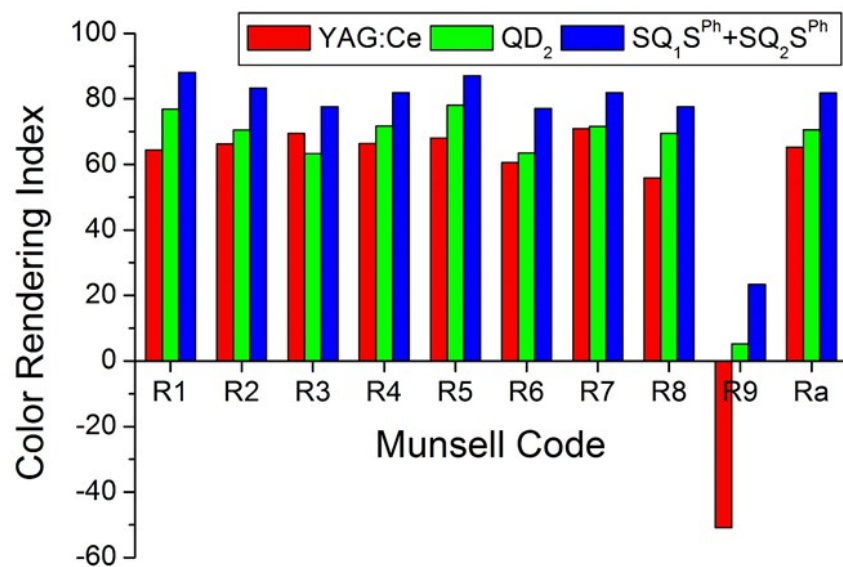


Figure S5. CRI of the white LEDs based on solely commercial YAG:Ce phosphors, with the addition of QD₂, and with the addition of the mixture of SQ₁S^{Ph} and SQ₂S^{Ph} operated at 60 mA.

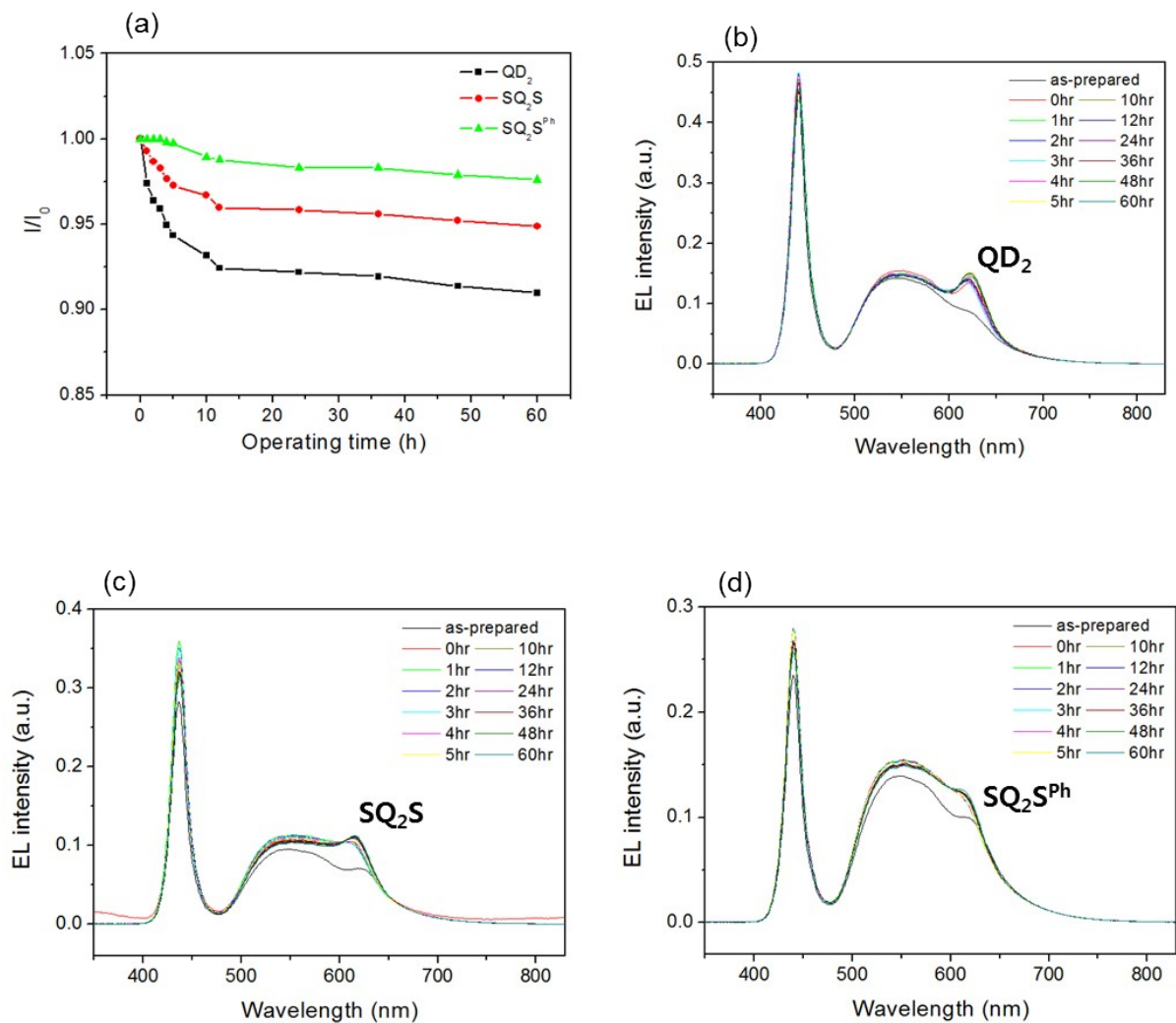


Figure S6. (a) Temporal normalized EL intensities and the corresponding temporal evolution of EL spectrum from a YAG:Ce phosphor- and (b) QD_2 -, (c) SQ_2S -, and (d) SQ_2S^{Ph} -based white LED operated at 60 mA 6 months after fabrication.

Table S1. Summary of the performances of various down-converter- and YAG:Ce phosphor-based white LEDs operated at 60 mA

LED #	Phosphors: YAG:Ce + Red P.	Color Coordinate (x, y)	CRI	LE (lm/W)	CCT (K)
I	-	(0.2965, 0.3205)	65.2	78.9	7574
II	QD ₁	(0.3853, 0.3272)	78.1	39.6	3387
III	QD ₂	(0.2955, 0.2955)	70.6	37.1	8232
IV	SQ ₁ S	(0.3337, 0.3492)	72.7	42.5	5451
V	SQ ₂ S	(0.3315, 0.3397)	72.0	39.9	5539
VI	SQ ₁ S + SQ ₂ S	(0.3298, 0.3198)	80.0	44.1	5626
VII	SQ ₁ S ^{Ph}	(0.3516, 0.3702)	72.7	50.5	4835
VIII	SQ ₂ S ^{Ph}	(0.3431, 0.3697)	71.7	47.8	5124
IX	SQ ₁ S ^{Ph} + SQ ₂ S ^{Ph}	(0.3360, 0.3355)	81.8	58.2	5338

*Subscript 1 and 2 denote the emitting wavelengths, 611 nm and 620 nm, respectively.