## Synthesis of color-tunable Cu–In–Ga–S solid solution quantum dots with high quantum yields for application to white light-emitting diodes

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Fig. S1. Plots of lattice parameters (a) a and (b) c of CIGS QDs as a function of In:Ga ratio.



Fig. S2. EDS spectra of (a) CIGS and (b) CIGS/ZnS QDs having various In:Ga ratios.

Flement	In:Ga (at %) in CIGS core QDs						
	0:1.0	0.3:0.7	0.5:0.5	0.7:1.0	1.0:0		
Cu	7.60	7.77	7.72	7.76	7.39		
In	-	10.19	15.57	20.91	29.07		
Ga	30.13	22.79	15.08	9.40	-		
Element	In:Ga (at %) in CIGS/ZnS core/shell QDs						
	0:1.0	0.3:0.7	0.5:0.5	0.7:1.0	1.0:0		
Cu	1.48	1.45	1.55	1.40	1.21		
In	-	1.88	3.50	3.85	4.98		
Ga	5.83	4.12	3.35	1.61	-		
Zn	39.77	41.10	45.05	38.48	34.12		

**Table S1.** EDS-based chemical compositions of CIGS and CIGS/ZnS QDs having various In:Ga ratios.



**Fig. S3.** Converted plots of  $(Ahv)^2$  versus hv of (a) CIGS and (b) CIGS/ZnS QDs from the absorption spectra of Figure 3(a,b), respectively, for determining the band gap by extrapolating the straight part of the graph to energy hv axis.



**Fig. S4.** UV-visible absorption spectra of (a) CIS,  $CI_{0.5}G_{0.5}S$ , CGS and (b) the respective core/shell QDs with a stoichiometric Cu:(In+Ga) precursor ratio of 1:1.



**Fig. S5.** Comparison of EL spectra of CGS/ZnS QD-based LED versus bare blue LED at a forward current of 20 mA.



**Fig. S6.** EL spectra of white QD-LEDs combined with (a) Cu-In0.3-Ga0.7-S/ZnS and (b) Cu-In-S/ZnS QDs as a function of forward current.

Cu–In0.3 –Ga0.7–S core/shell QDs								
Forward Current (mA)	Luminous Efficacy (lm/W)	Conversion Efficiency (%)	CRI	CCT (K)	CIE Color Coordinates			
10	81.0	76	71	6857	(0.307,0.324)			
20	69.1	74	72	7048	(0.305,0.320)			
30	60.5	72	72	7198	(0.303,0.317)			
40	53.9	70	72	7363	(0.302,0.314)			
50	48.6	69	72	7472	(0.301,0.312)			
60	44.2	67	72	7472	(0.300,0.312)			
70	40.2	66	72	7527	(0.299,0.312)			
80	37.0	65	72	7582	(0.299,0.311)			
90	34.1	64	72	7692	(0.298,0.310)			
100	31.6	64	72	7692	(0.298,0.309)			
	Cu–In–S core/shell QDs							
Forward Current	Luminous	Conversion	CRI		<b>CIE Color</b>			
(mA)	Efficacy (lm/W)	Efficiency (%)	CIU		Coordinates			
(mA) 10	Efficacy (lm/W) 85.4	Efficiency (%) 96	71	3923	<b>Coordinates</b> (0.358,0.288)			
(mA) 10 20	Efficacy (lm/W) 85.4 75.0	<b>Efficiency (%)</b> 96 96	71 71	3923 3892	Coordinates (0.358,0.288) (0.359,0.288)			
(mA) 10 20 30	Efficacy (lm/W) 85.4 75.0 66.4	Efficiency (%)         96         96         94	71 71 71 71	3923 3892 3938	Coordinates (0.358,0.288) (0.359,0.288) (0.357,0.286)			
(mA) 10 20 30 40	Efficacy (lm/W) 85.4 75.0 66.4 60.0	Efficiency (%) 96 96 94 93	71 71 71 71 71	3923 3892 3938 3954	Coordinates           (0.358,0.288)           (0.359,0.288)           (0.357,0.286)           (0.356,0.285)			
(mA) 10 20 30 40 50	Efficacy (lm/W) 85.4 75.0 66.4 60.0 54.5	Efficiency (%) 96 96 94 93 92	71 71 71 71 71 71 72	3923 3892 3938 3954 4033	Coordinates (0.358,0.288) (0.359,0.288) (0.357,0.286) (0.356,0.285) (0.355,0.283)			
(mA) 10 20 30 40 50 60	Efficacy (lm/W) 85.4 75.0 66.4 60.0 54.5 50.0	Efficiency (%) 96 96 94 93 93 92 91	71 71 71 71 71 71 72 72	3923 3892 3938 3954 4033 4050	Coordinates         (0.358,0.288)         (0.359,0.288)         (0.357,0.286)         (0.356,0.285)         (0.355,0.283)         (0.354,0.282)			
(mA) 10 20 30 40 50 60 70	Efficacy (lm/W) 85.4 75.0 66.4 60.0 54.5 50.0 46.1	Efficiency (%) 96 96 94 93 93 92 91 90	71       71       71       71       71       71       72       72       72	3923         3923         3892         3938         3954         4033         4050         4067	Coordinates (0.358,0.288) (0.359,0.288) (0.357,0.286) (0.356,0.285) (0.355,0.283) (0.354,0.282) (0.353,0.281)			
(mA) 10 20 30 40 50 60 70 80	Efficacy (lm/W) 85.4 75.0 66.4 60.0 54.5 50.0 46.1 42.6	Efficiency (%) 96 96 94 93 93 92 91 91 90 90	71       71       71       71       71       71       72       72       72       72       72       72	3923         3923         3892         3938         3954         4033         4050         4067         4084	Coordinates         (0.358,0.288)         (0.359,0.288)         (0.357,0.286)         (0.356,0.285)         (0.355,0.283)         (0.354,0.282)         (0.353,0.281)         (0.353,0.280)			
(mA) 10 20 30 40 50 60 70 80 90	Efficacy (lm/W) 85.4 75.0 66.4 60.0 54.5 50.0 46.1 42.6 39.6	Efficiency (%) 96 96 94 93 93 92 91 91 90 90 90 89	71       71       71       71       71       71       72       72       72       72       72       73	3923         3923         3892         3938         3954         4033         4050         4067         4084         4117	Coordinates (0.358,0.288) (0.359,0.288) (0.357,0.286) (0.356,0.285) (0.355,0.283) (0.354,0.282) (0.353,0.281) (0.353,0.280) (0.352,0.279)			

**Table S2.** Variations of luminous efficacy, conversion efficiency, CRI, and CCT of white QD-LEDs in Figure S5 as a function of forward current.