

Electronic Supplementary Information

# Controlling visible-light driven photocatalytic activity of alloyed ZnSe-AgInSe<sub>2</sub> quantum dots for hydrogen production

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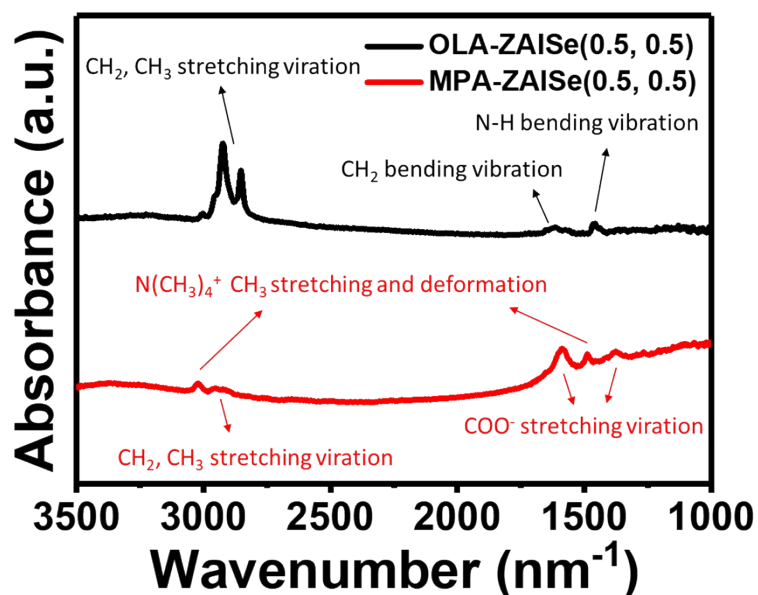
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**Table S1.** Fitting results of TRPL data for OLA-ZAISe( $x$ , 0.5) and MPA-ZAISe( $x$ , 0.5) with various  $x$  values.

	Ligand	A <sub>1</sub> (%)	$\tau_1$ (ns)	A <sub>2</sub> (%)	$\tau_2$ (ns)	A <sub>3</sub> (%)	$\tau_3$ (ns)	$\langle\tau\rangle_{\text{avg}}$	$X^2$	$k_{\text{ct}}(10^6 \text{ s}^{-1})$
$x=0.1$	OLA	2.5	194	14.4	43.9	83.1	3.57	87.4	1.03	0.858
	MPA	2.6	184	18.3	36.6	79.1	3.21	81.3	1.08	
$x=0.3$	OLA	11.4	259	21.0	53.7	67.6	4.04	189	1.03	3.18
	MPA	5.8	192	17.7	33.2	76.5	3.88	118	1.09	
$x=0.5$	OLA	9.4	446	25.6	92.4	65.0	4.56	305	1.08	3.30
	MPA	5.4	234	15.0	32.6	79.6	4.02	152	1.01	
$x=0.7$	OLA	8.2	262	26.2	62.9	65.6	4.44	163	1.08	0.858
	MPA	4.5	249	16.9	42.7	78.6	4.09	143	1.02	
$x=0.9$	OLA	8.8	158	34.4	38.0	56.8	4.60	91.0	1.14	9.97
	MPA	0.8	186	16.4	23.2	82.8	3.33	47.7	1.03	



**Fig. S1** FTIR spectra of ZAISe(0.5, 0.5) QDs modified with OLA (black line) and MPA (red line).

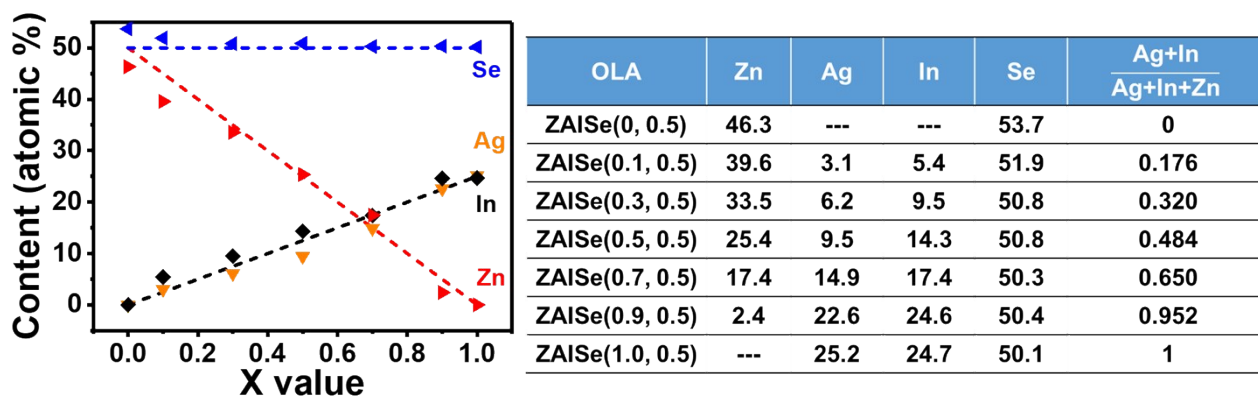


Fig. S2 Chemical compositions of OLA-ZAISe( $x$ , 0.5) QDs with various  $x$  values. Dashed lines represent theoretical values estimated from the ratios of precursor concentrations.

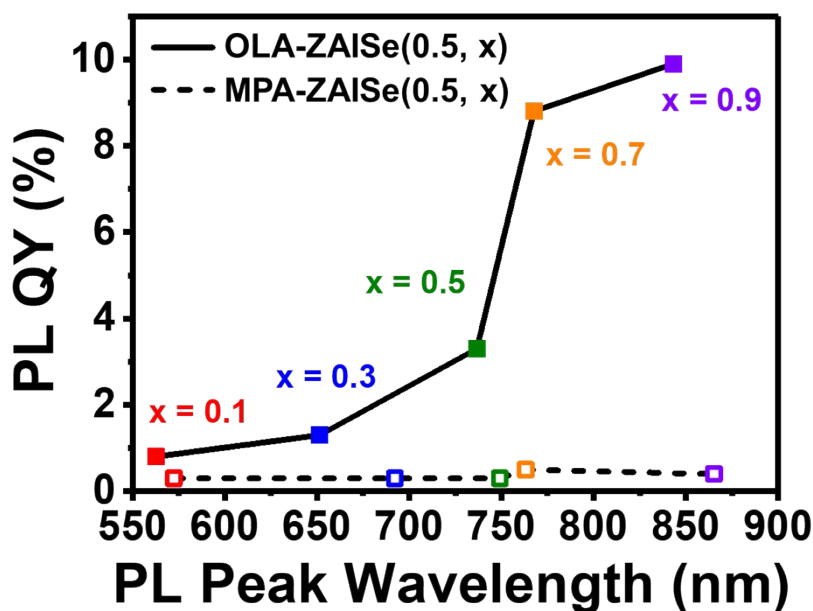


Fig. S3 Relationship between PL QY and the peak wavelength of PL spectra for OLA-ZAISe( $x$ , 0.5) and MPA-ZAISe( $x$ , 0.5) with various  $x$  values.

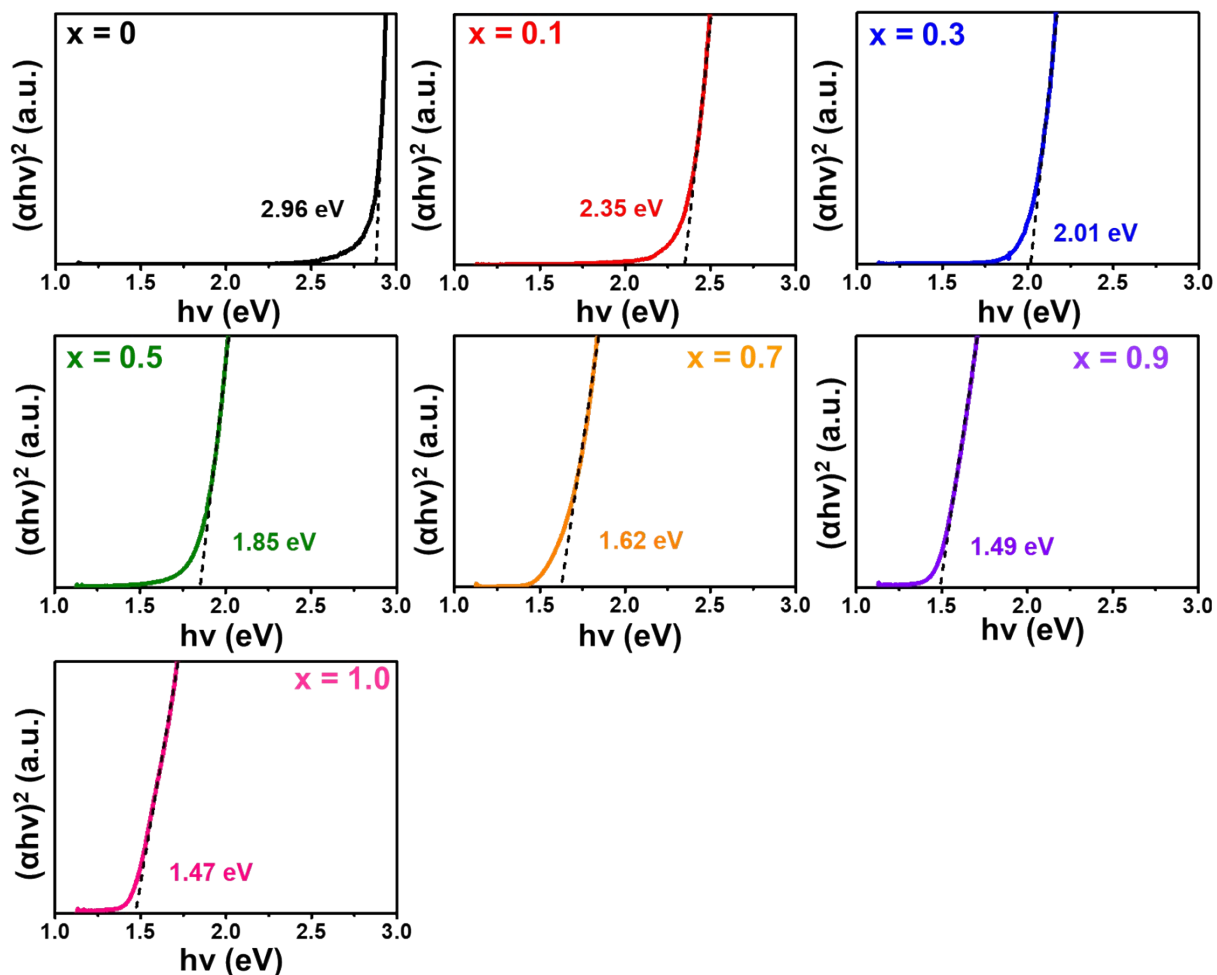


Fig. S4 Tauc plots for calculating the bandgap of OLA-ZAISe( $x$ , 0.5) with different  $x$  values.

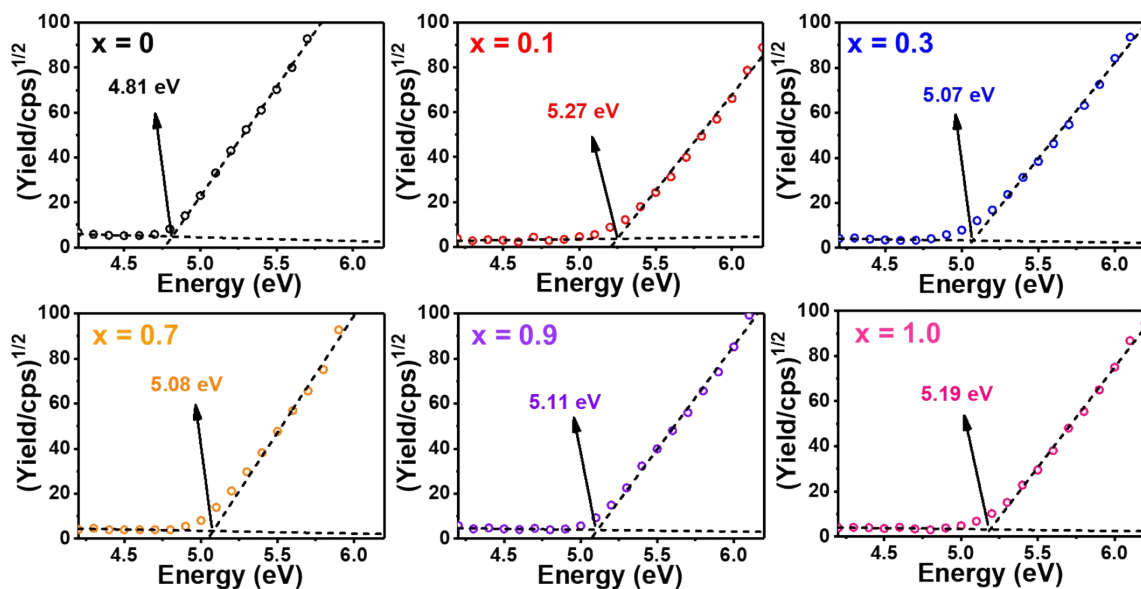
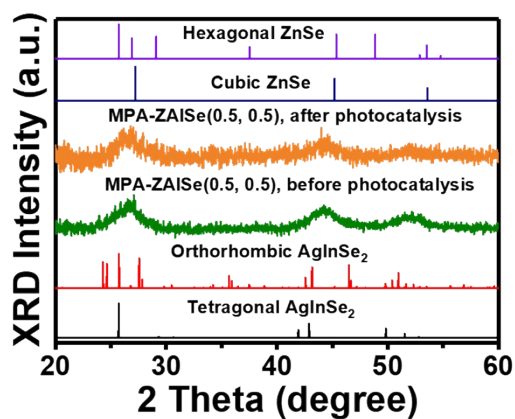
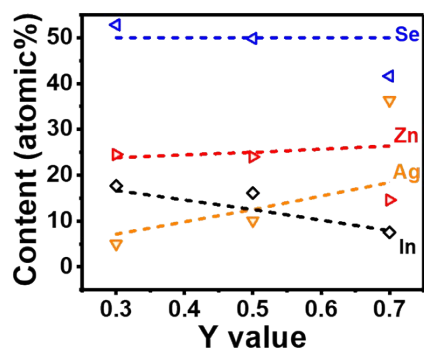


Fig. S5 PYSA spectra of OLA-ZAISe( $x$ , 0.5) with varied  $x$  values. The number in each panel is the onset photon energy, that is, the ionization energy determined.



MPA-ZAISe(0.5, 0.5)	Zn	Ag	In	Se	x
before photocatalysis	24.03	10.13	16.02	49.82	0.52
after photocatalysis	24.85	10.88	15.85	48.42	0.52

Fig. S6 XRD patterns and EDX data for MPA-ZAISe(0.5, 0.5) before and after the photocatalytic reaction.



MPA	Zn	Ag	In	Se	Ag+In Ag+In+Zn	Ag Ag+In
ZAISe(0.5, 0.3)	24.5	5.0	17.7	52.8	0.481	0.220
ZAISe(0.5, 0.5)	24.0	10.1	16.1	49.8	0.521	0.385
ZAISe(0.5, 0.7)	14.6	36.3	7.5	41.6	0.750	0.829

Fig. S7 Chemical compositions of MPA-ZAISe(0.5, y) with various y values. Dashed lines represent theoretical values estimated from the ratios of precursor concentrations.

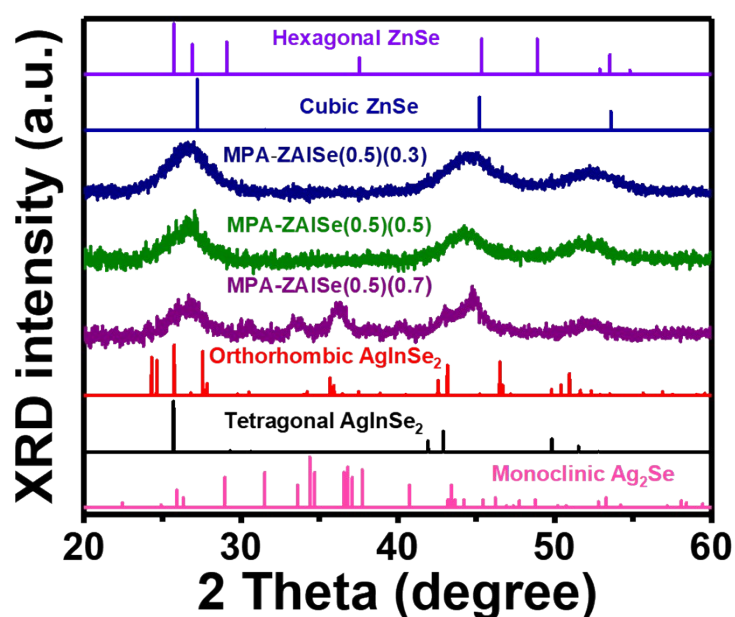


Fig. S8 XRD patterns of MPA-ZAISe(0.5,  $y$ ) with varied  $y$  values.

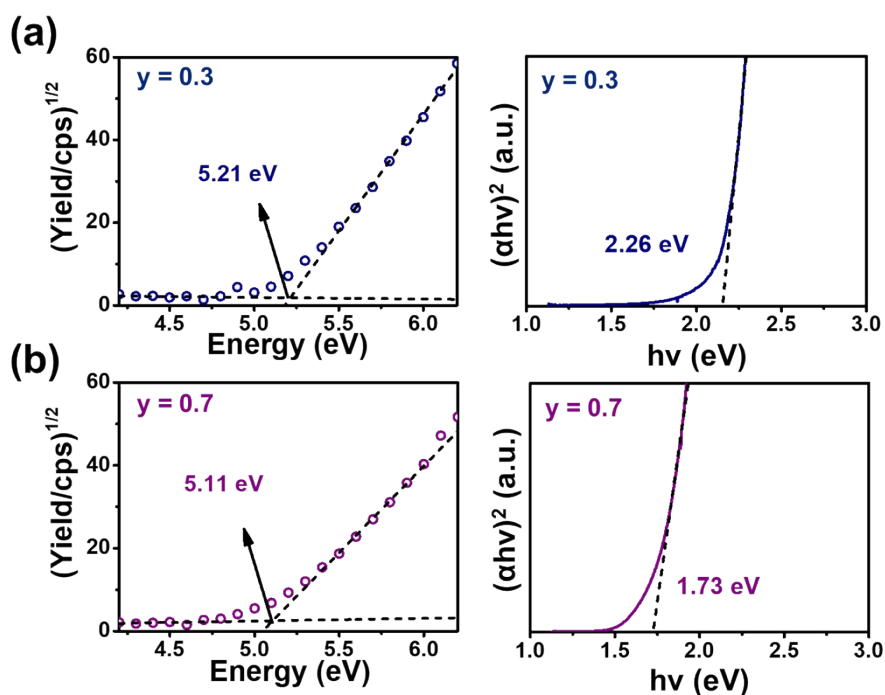


Fig. S9 PYSA spectra and Tauc plots of ZAISe(0.5,  $y$ ) with  $y=0.3$ (a) and  $0.7$ (b).

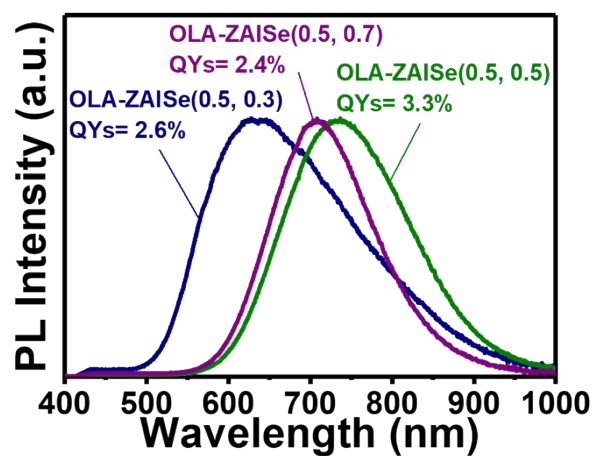


Fig. S10 PL spectra of OLA-ZAISe(0.5,  $y$ ) with varied  $y$  values. Corresponding PL QYs are shown in the panel.