

## Supporting Information

### **Surface defect mitigation via alkyl-ligand-controlled purification for stable and high-luminescence perovskite quantum dots**

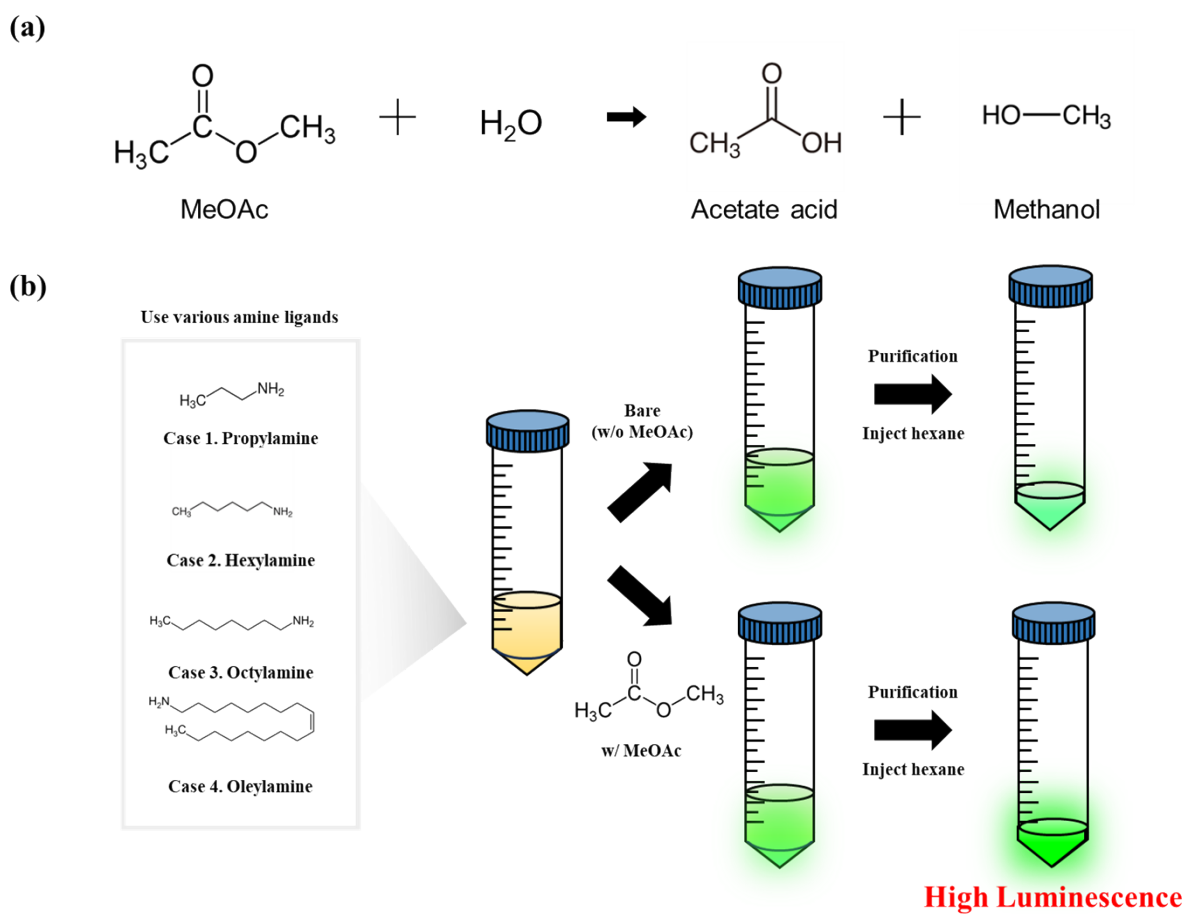
*Tae Yong Im<sup>1</sup>, Jin Young Kim<sup>2</sup>, Woongsik Jang<sup>2</sup>, Dong Hwan Wang<sup>1, 2,\*</sup>*

<sup>1</sup>School of Integrative Engineering, Chung-Ang University, 84 Heukseok-Ro, Dongjak-gu, Seoul 06974, Republic of Korea

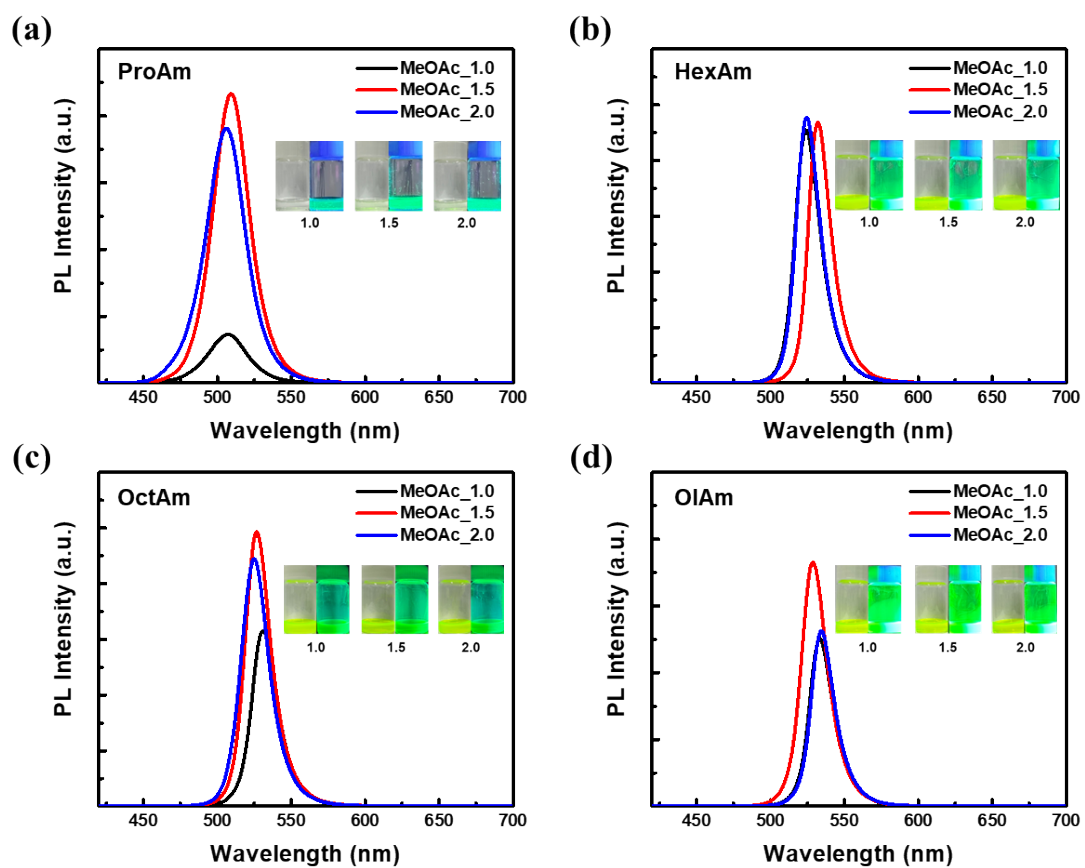
<sup>2</sup>Department of Intelligent Semiconductor Engineering, Chung-Ang University, 84 Heukseok-Ro, Dongjak-gu, Seoul 06974, Republic of Korea

---

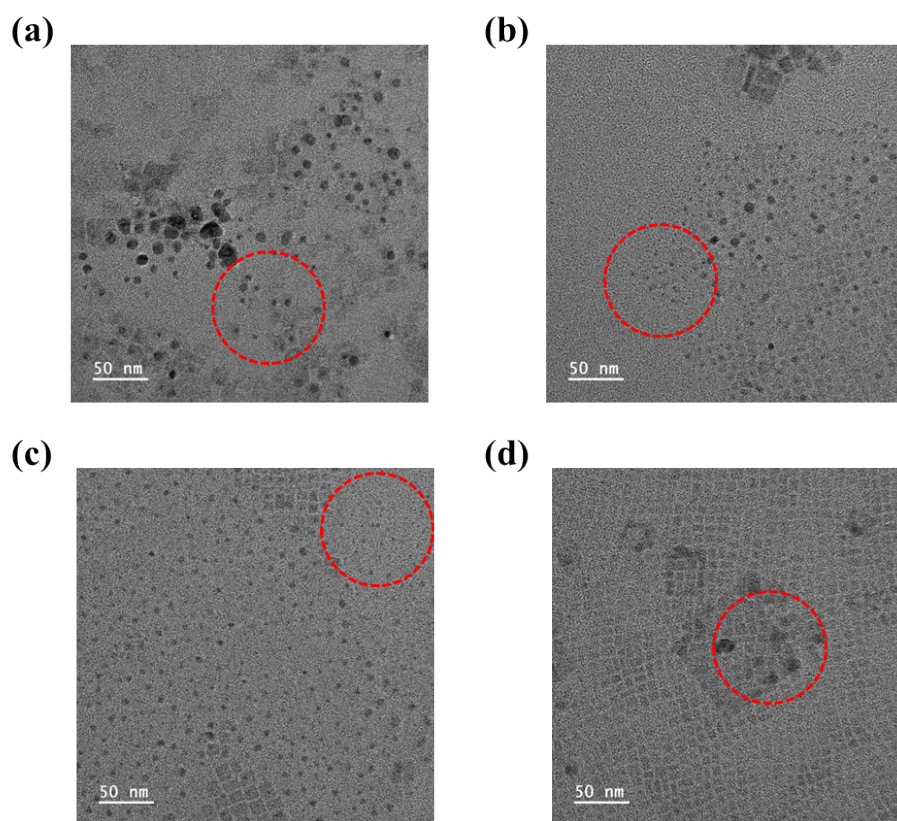
\* Corresponding authors, E-mail addresses: king0401@cau.ac.kr (Prof. D.H. Wang)



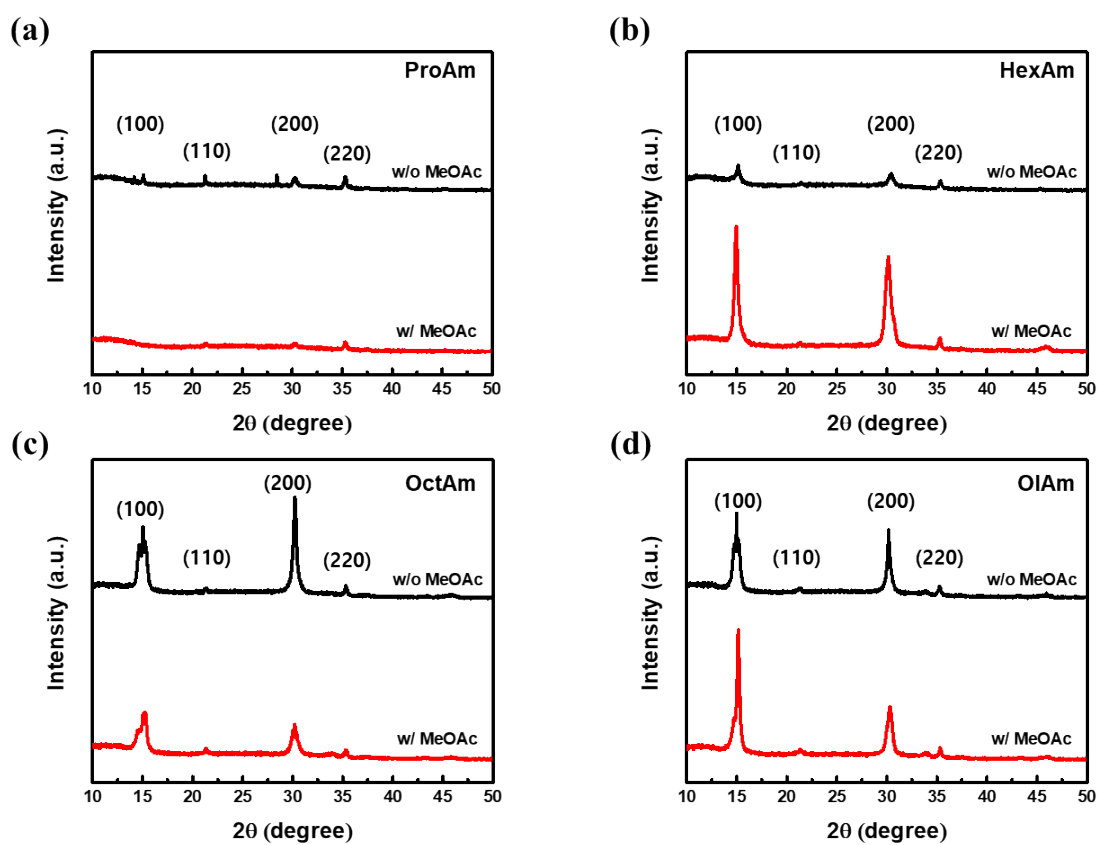
**Fig. S1.** (a) Hydrolysis reaction process of MeOAc. (b) A schematic diagram showing (left) the chemical structures of the various ligands and (right) the preparation of the as-synthesized ligand-engineered PQDs solutions for purification via centrifugation without (top) and with (bottom) MeOAc.



**Fig. S2.** PL intensities of the PQDs solutions with (a) ProAm, (b) HexAm, (c) OctAm, and (d) OlAm, according to PQDs solution and MeOAc volume ratio. The insets show photographic images of the solutions under ambient light (left) and UV-365 (right).

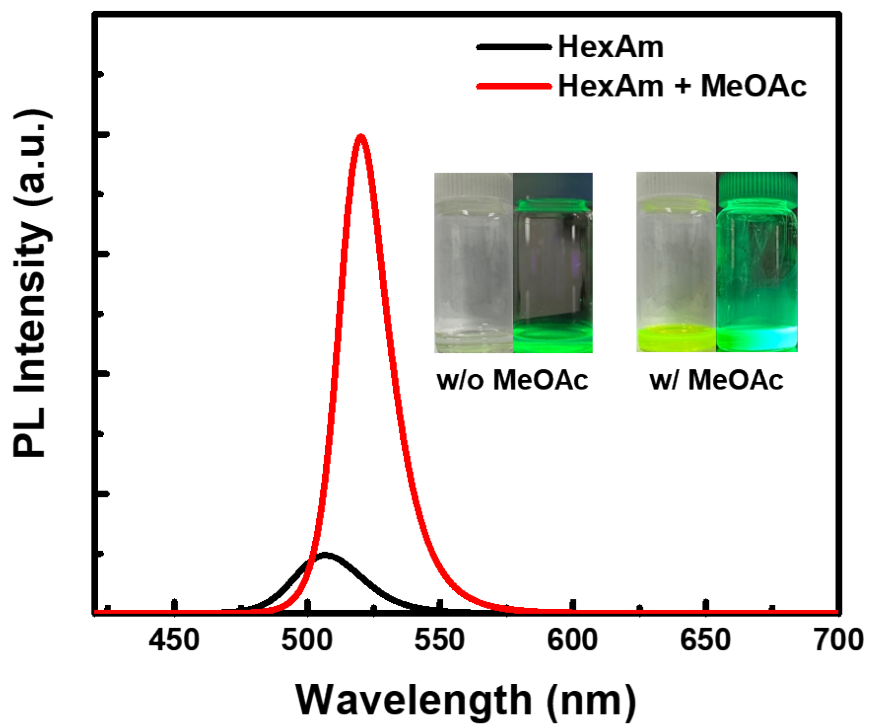


**Fig. S3.** The TEM images of the as-synthesized PQDs with (a) ProAm, (b) HexAm, (c) OctAm, and (d) OlAm.

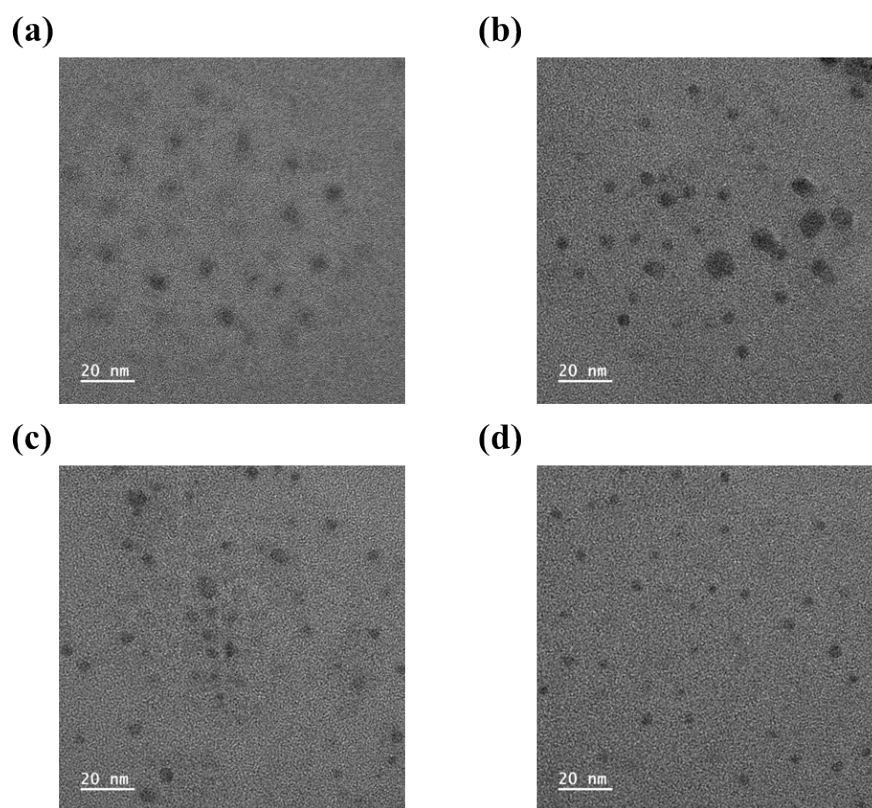


F

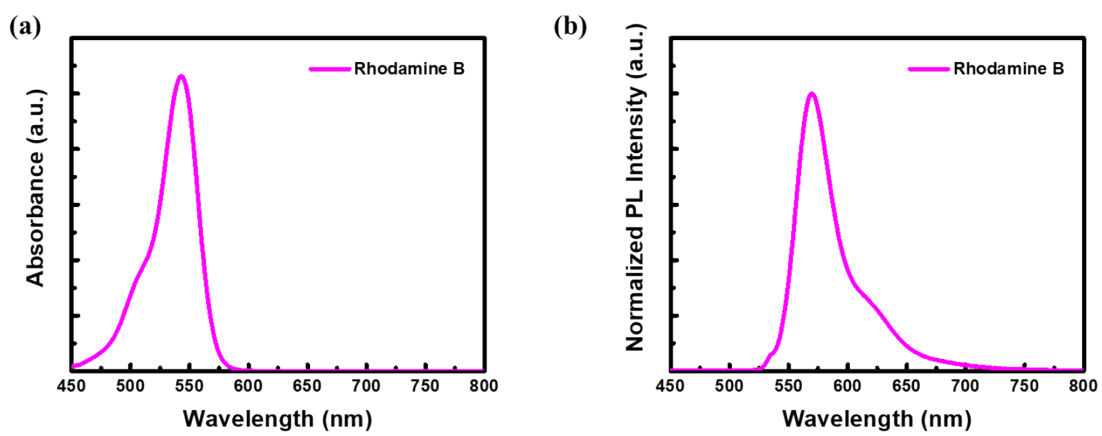
**ig. S4.** The solution-state XRD patterns of the PQDs with (a) ProAm, (b) HexAm, (c) OctAm, and (d) OIAm, without (black lines) and with (red lines) MeOAc treatment.



**Fig. S5.** PL intensities of the PQDs solutions with HexAm with (red) and without (black) MeOAc treatment. The insets show photographic images of the solutions under ambient light (left) and UV-365 (right)

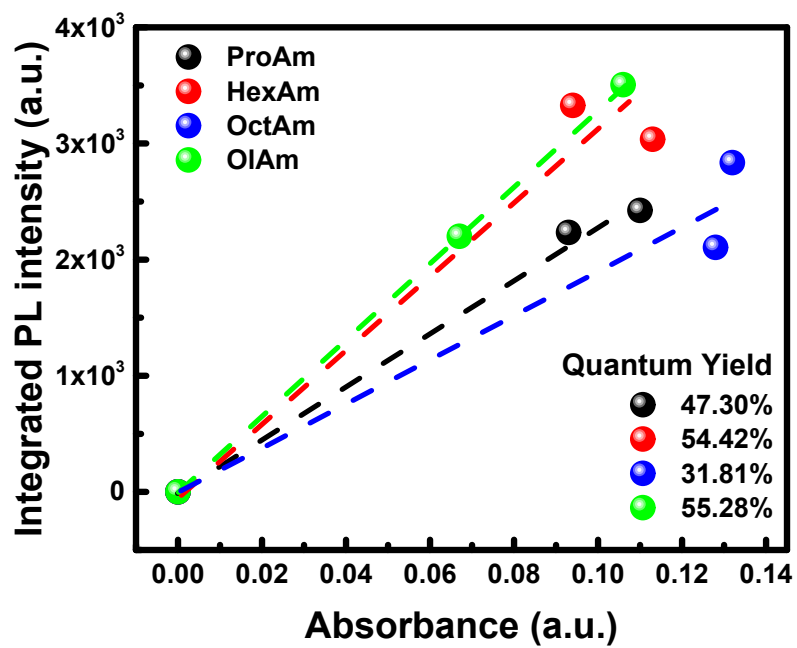


**Fig. S6.** The TEM images of the PQDs with (a) ProAm, (b) HexAm, (c) OctAm, and (d) OlAm.

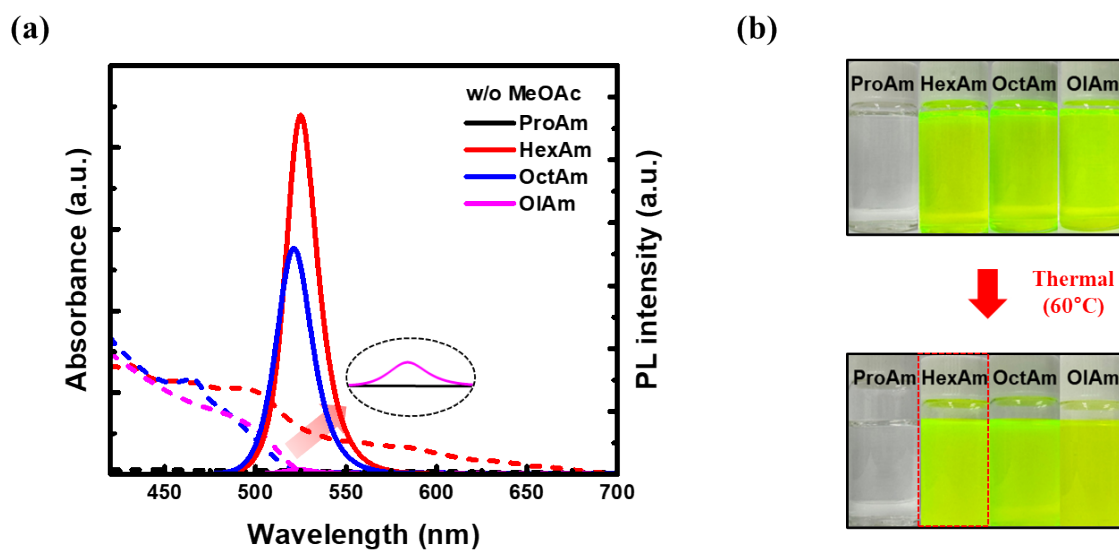


**Fig. S7.** (a) Absorption spectrum and (b) normalized PL spectrum of Rhodamine B.

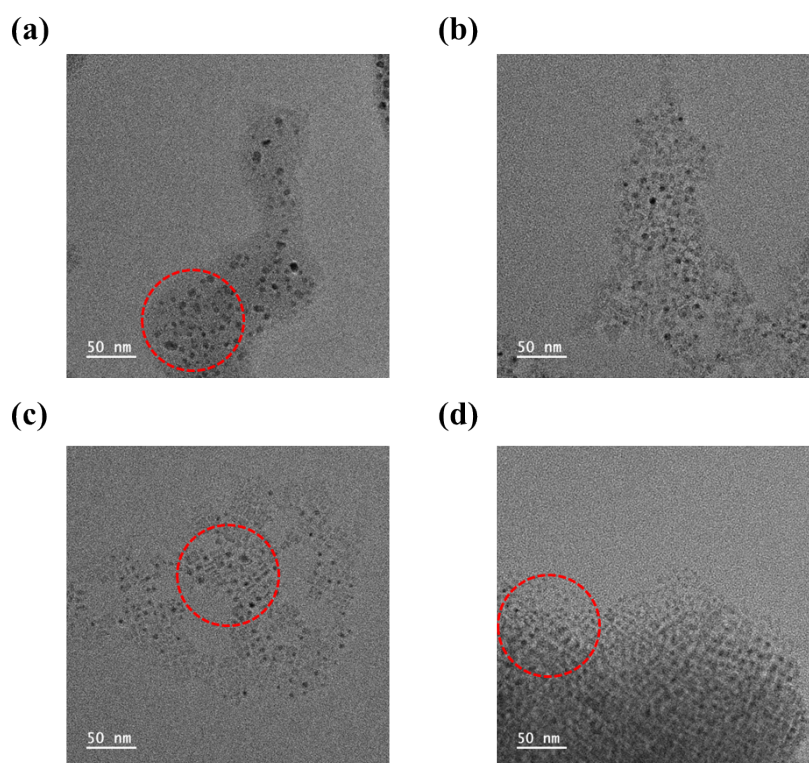




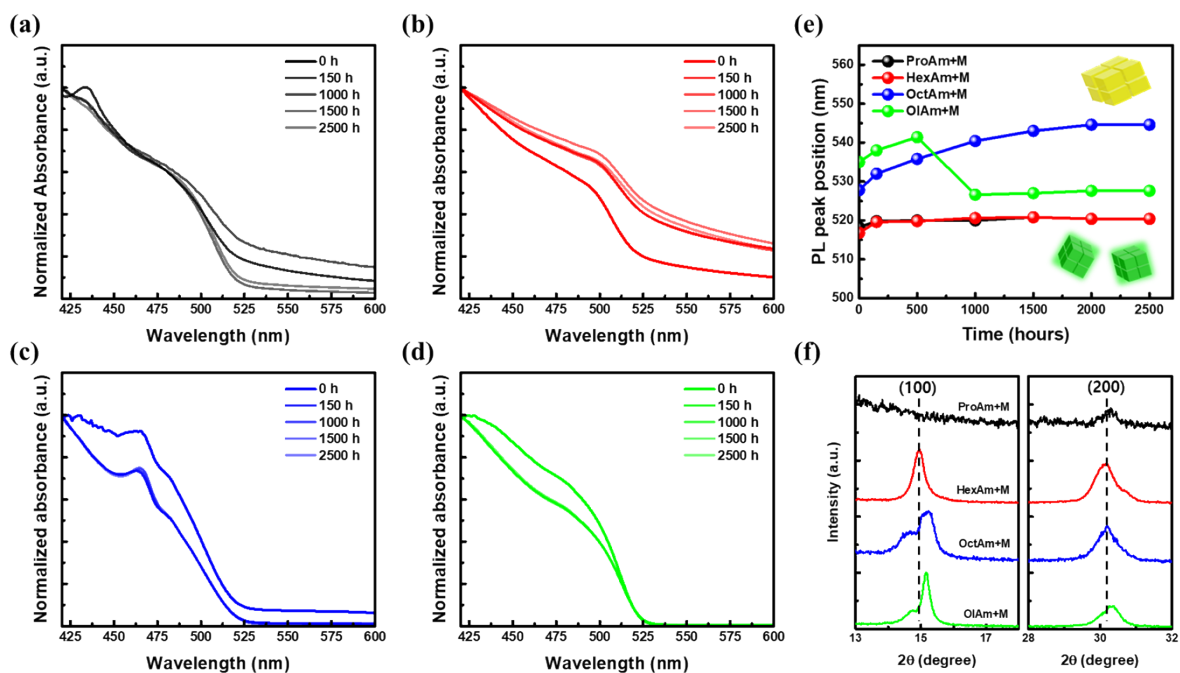
**Fig. S8.** The plots of integrated PL intensity against absorbance, and the corresponding PLQY values.



**Fig. S9.** (a) The absorbances (left-hand axes) and PL intensities (right-hand axes) of the MeOAc-treated PQDs solutions according to ligand alkyl-chain length after annealing at 60°C, and (b) photographic images of the PQDs solutions under sunlight before (top) and after (bottom) annealing.



**Fig. S10.** The TEM images of the PQDs after thermal treatment with (a) ProAm, (b) HexAm, (c) OctAm, and (d) OlAm.



**Fig. S11.** (a-d) The time-dependent solution-state normalized absorbances of the MeOAc-treated PQDs solutions with (a) ProAm, (b) HexAm, (c) OctAm, and (d) OIAm during storage under ambient conditions. (e) Time-dependent PL peak position of PQDs solution with MeOAc synthesized with different amine ligands. (f) Enlarged XRD patterns of the MeOAc-treated PQDs with amine ligands.

**Table S1.** The PL peak emission and FWHM of various PQDs solutions according to the

<b>Ligand</b>	<b>Volume (<math>\mu\text{l}</math>)</b>	<b>PL peak emission (nm)</b>	<b>FWHM (nm)</b>
<b>ProAm</b>	5	522.4	25.21
	10	522.6	26.05
	15	512.6	22.9
	20	501.6	36.06
	25	490.0	30.96
<b>HexAm</b>	5	524.6	42.41
	10	506.4	30.76
	15	484.6	38.52
	20	472.4	33.82
	25	453.8	57.98
<b>OctAm</b>	5	527.0	23.59
	10	534.6	18.49
	15	532.2	18.96
	20	525.2	22.56
	25	518.2	28.96
<b>OIAm</b>	5	522.2	23.72
	10	535.4	19.21
	15	535	19.17
	20	537.8	19.11
	25	534.2	19.71

volume ( $\mu\text{l}$ ) of each ligand.

**Table S2.** The PL peak emission and FWHM of the various PQDs solutions according to the

<b>Ligand</b>	<b>v/v ratio</b>	<b>PL peak emission (nm)</b>	<b>FWHM (nm)</b>
<b>ProAm</b>	1:0.5	516.0	38.89
	1:1.0	507.0	31.15
	1:1.5	509.6	29.04
	1:2.0	506.2	31.11
	1:2.5	495.6	44.08
<b>HexAm</b>	1:0.5	518.0	29.19
	1:1.0	524.0	20.45
	1:1.5	532.0	18.20
	1:2.0	524.4	19.52
	1:2.5	529.2	19.60
<b>OctAm</b>	1:0.5	525.0	21.49
	1:1.0	530.8	20.56
	1:1.5	526.6	20.42
	1:2.0	525.0	22.14
	1:2.5	523.2	21.90
<b>OIAm</b>	1:0.5	534.6	20.92
	1:1.0	533.4	19.96
	1:1.5	530.2	19.93
	1:2.0	534.6	18.71
	1:2.5	535.0	20.76

as-synthesized PQDs solution and MeOAc v/v ratio.

**Table S3.** The PL peak emission and FWHM of the various PQDs solutions with and without MeOAc treatment.

<b>Ligand</b>	<b>MeOAc</b>	<b>PL peak emission (nm)</b>	<b>FWHM (nm)</b>
<b>ProAm</b>	w/o	512.6	30.25
	w/	504.4	31.47
<b>HexAm</b>	w/o	506.4	30.76
	w/	520.0	22.39
<b>OctAm</b>	w/o	521.4	20.04
	w/	525.8	20.77
<b>OlAm</b>	w/o	531.2	19.39
	w/	531.2	19.50

**Table S4.** The data used to calculate the relative PLQY values.

<b>Sample</b>	<b>Solvent</b>	<b>Refractive index</b>	<b>Gradient (F/A)</b>	<b>QY (%)</b>
ProAm	Hexane	1.375	$2.30 \times 10^4$	47.30
HexAm	Hexane	1.375	$3.11 \times 10^4$	54.42
OctAm	Hexane	1.375	$2.15 \times 10^4$	31.81
OlAm	Hexane	1.375	$3.31 \times 10^4$	55.28



**Table S5.** Time resolved photoluminescence decay characterization of MeOAc-treated PQDs solutions with various amine ligands.

<b>Sample</b>	<b><math>\tau_1</math> (ns)</b>	<b><math>\tau_2</math> (ns)</b>	<b><math>\tau_{avg}</math> (ns)</b>
ProAm + MeOAc	1.06	6.16	3.33
HexAm + MeOAc	3.33	12.07	9.98
OctAm + MeOAc	2.43	7.64	7.32
OlAm + MeOAc	3.42	10.33	7.32