Electronic Supporting Information

Violet Phosphorus Quantum Dots

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Structure characterizations

TEM and HRTEM images were taken by Talos F200X electron microscope with an acceleration voltage of 200 kV. The TEM sample was dropped on a Cu grid coated with an ultrathin amorphous carbon film and then dried under an ambient condition. AFM images of VPQDs were taken with Peak Force Tapping from Bruker Dimension ICON. Raman spectra were taken in a back-scattering geometry using a single monochromator with a microscope (Reinishaw inVia) equipped with CCD array detector and an edge filter. The samples were excited by lasers with a wavelength of 633 nm. X-ray diffraction patterns were obtained from a Bruker D2 PHASER using Cu/Kαradiation (λ=1.5418 Å) at 40 kV and 30 mA. The FT-IR spectra of the samples were recorded in total reflection mode using a Fourier transform infrared spectrometer (Nicolet iN10 MX) with the wavelength range of 4000-525 cm^{-1} and a resolution of 8.0 cm^{-1}. A UV-vis-NIR spectrometer (JASCO, V-670) was used to measure the optical features. Fluorescence spectra and fluorescence decay spectra were performed using an Edinburgh FLS980 instrument (Edinburgh, UK). The fluorescence spectra were obtained with excitation bandwidth of 5 nm, emission bandwidth of 0.8 nm, and dwell time of 0.3 s. The fluorescence decay spectra were obtained with lifetime window range of 200 ns and acquisition channel of 2048, which were stopped with peak counts reaching 30,000. Absolute quantum yield measurements were also performed on an Edinburgh FLS980 fluorescence spectrometer with an integrating sphere.

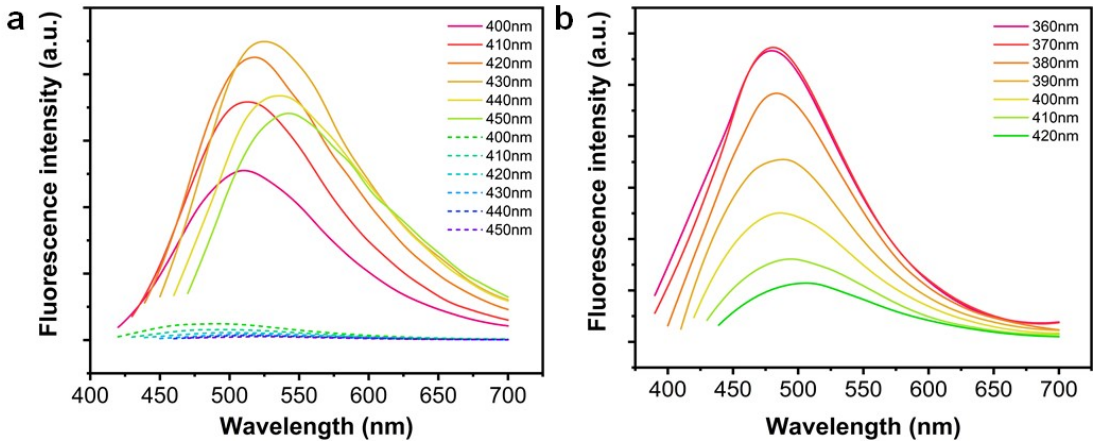

Fig. S1 (a) Fluorescence spectra of VPQDs (solid line) and NMP (dashed line) at different excitation wavelengths. (b) Fluorescence spectra near the most intense excitation wavelength of NMP.

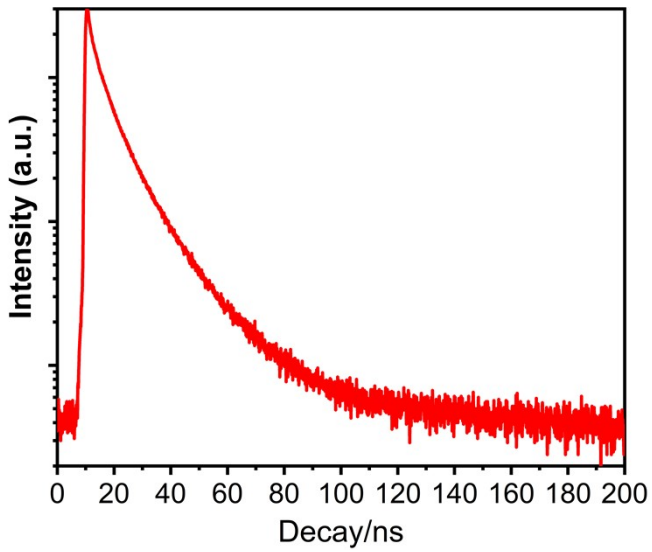

Fig. S2 PL decay curves of VPQDs.

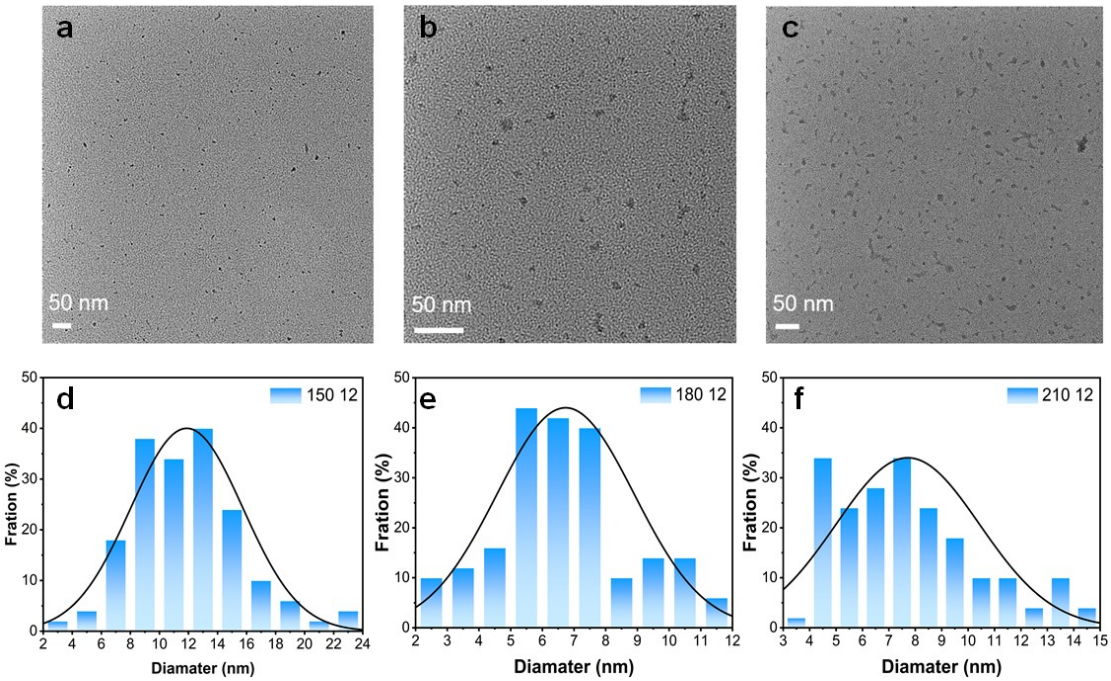

Fig. S3 TEM images and size distribution histograms of VPQDs prepared at different temperature: (a, d) 150 °C, (b, e) 180 °C, and (c, f) 210 °C for 12 h

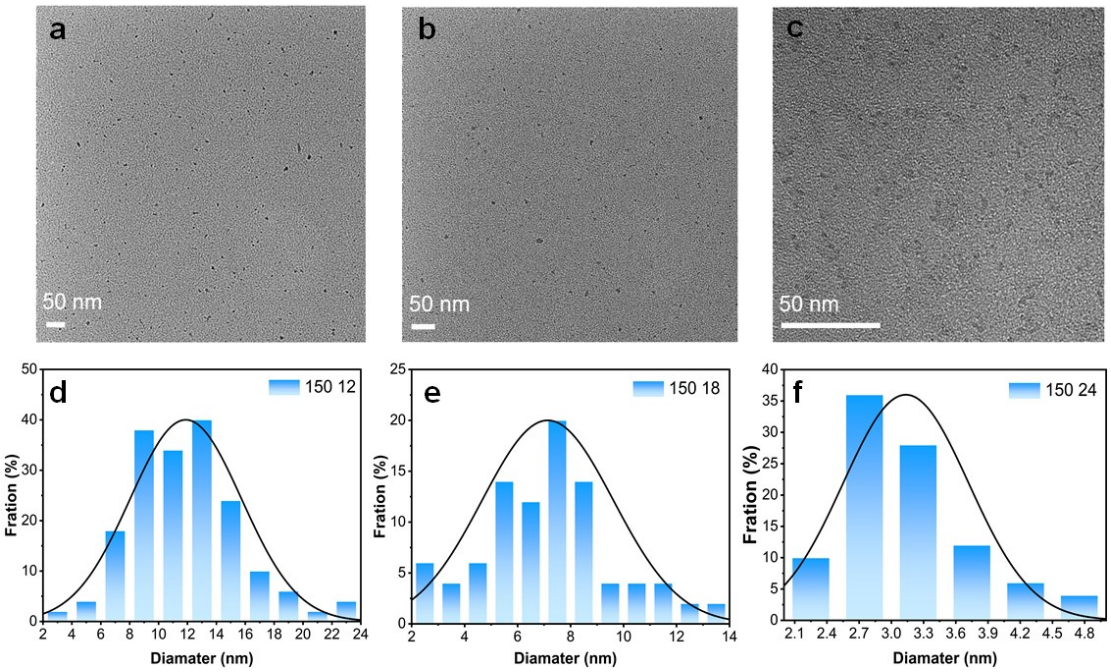

Fig. S4 TEM images and size distribution histograms of VPQDs prepared at 150 °C under different reaction time: (a, d) 12 h, (b, e) 18 h, and (c, f) 24 h.

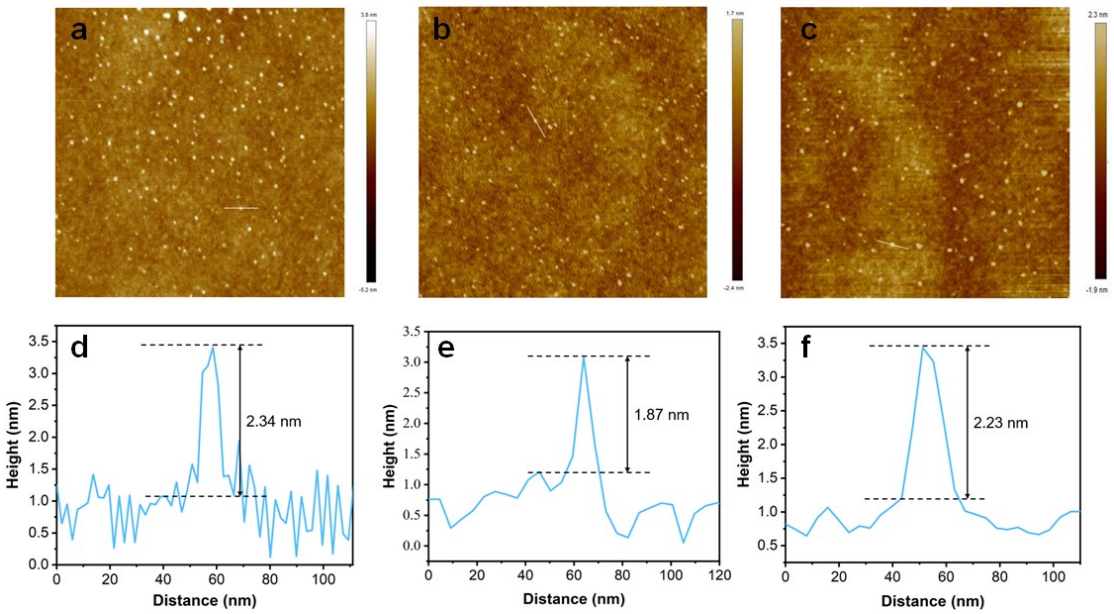

Fig. S5 AFM images and height statistics of VPQDs prepared at different temperatures (a, d) 150 °C, (b, e) 180 °C and (c, f) 210 °C for 12 h.

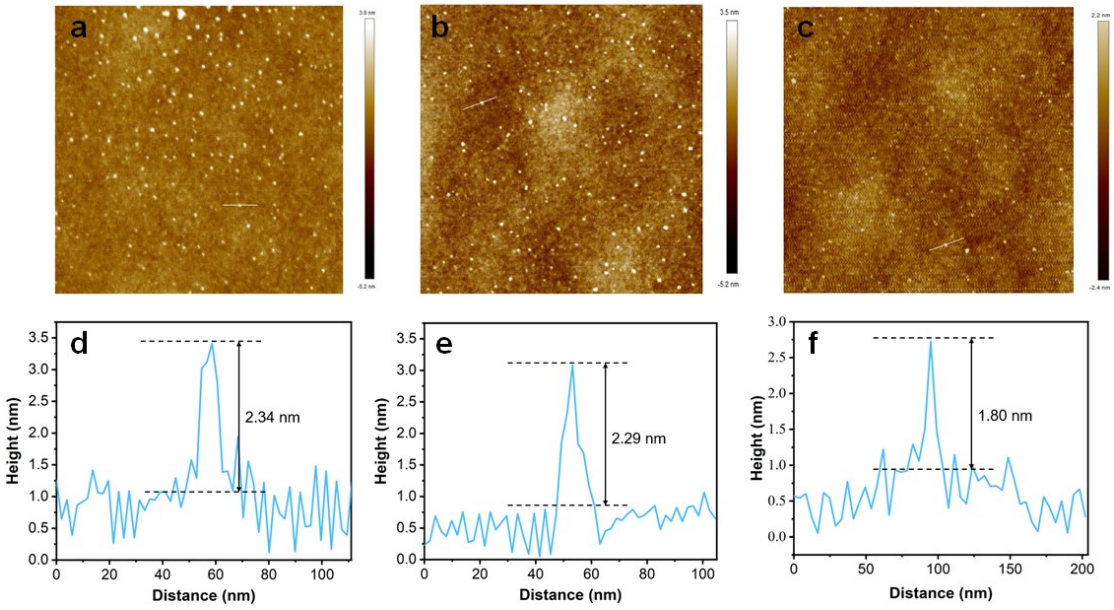

Fig. S6 AFM images and height statistics of VPQDs prepared at 150 °C at different reaction times. (a, d) 12 h, (b, e) 18 h, and (c, f) 24 h.

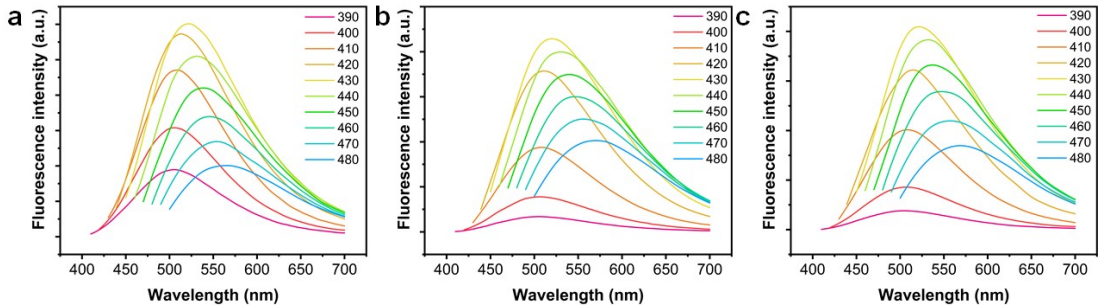

Fig. S7 Fluorescence spectra of VPQDs prepared at different temperature: (a) 150 °C, (b) 180 °C, and (c) 210 °C for 12 h.

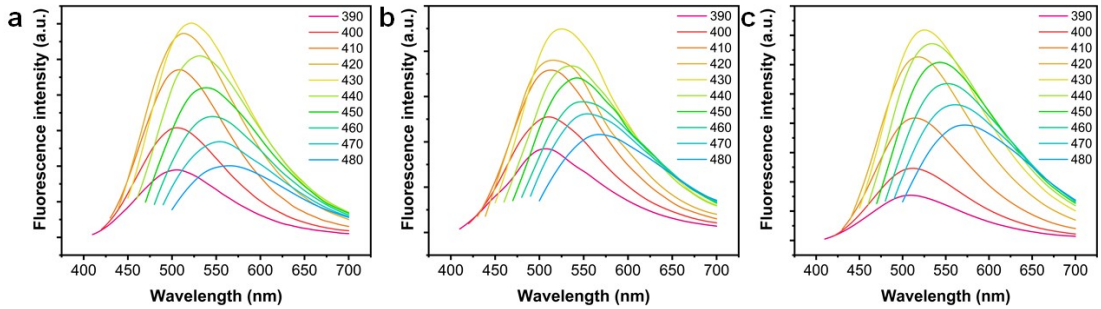

Fig. S8 Fluorescence spectra of VPQDs prepared at 150 °C under different reaction time: (a) 12 h, (b) 18 h, and (c) 24 h.

Table S1. Fluorescence lifetime components and proportions of VPQDs prepared at different temperature.

Temperature	τ_1	A_1%	τ_2	A_2%	τ_3	A_3%	τ_{av}
150	1.2045	4.58	5.3231	44.13	14.1582	51.29	9.66 ns
180	2.3181	9.17	6.6214	48.65	16.0299	42.18	10.19 ns
210	1.3293	4.74	5.3066	45.65	14.1083	49.61	9.48 ns

Table S2. Fluorescence lifetime components and proportions of VPQDs prepared at different time.

Time	τ_1	A_1%	τ_2	A_2%	τ_3	A_3%	τ_{av}
12	1.2045	4.58	5.3231	44.13	14.1582	51.29	9.66 ns
18	2.0239	6.89	6.375	48.04	16.0552	45.07	10.44 ns
24	1.5975	7.7	6.384	53.4	16.7764	38.9	10.06 ns

Table S3. Comparison of sensing performances of different fluorescent probes for Cu^{2+}.

Fluorescence probes	Detection limit (μmol/L)	Work system	Ref.
CdS QDs	0.04	Water	[1]
CdSe/ZnS QDs	0.9	Water	[2]
CQDs	0.0507	Water	[3]
WS_2 QDs	0.4	Water	[4]
CdSe/ZnS	1.1	Water	[5]
CdS QDs	1.5	Water	[6]
BPQDs	16	Organic solvent	[7]
VPQDs	0.0196	Organic solvent	This work

References:

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