Electronic supplementary information

Purple-emissive carbon dots enhance sensitivity of Si photodetectors to ultraviolet range

Sergii Kalytchuk, Lukáš Zdražil, Magdalena Scheibe, and Radek Zbořil**

Regional Centre of Advanced Technologies and Materials, Department of Physical Chemistry, Palacký University Olomouc, Šlechtitelů 27, 783 71 Olomouc, Czech Republic

*Corresponding author's e-mail: radek.zboril@upol.cz (R. Zbořil), sergii.kalytchuk@upol.cz (S.Kalytchuk)

Table of Contents

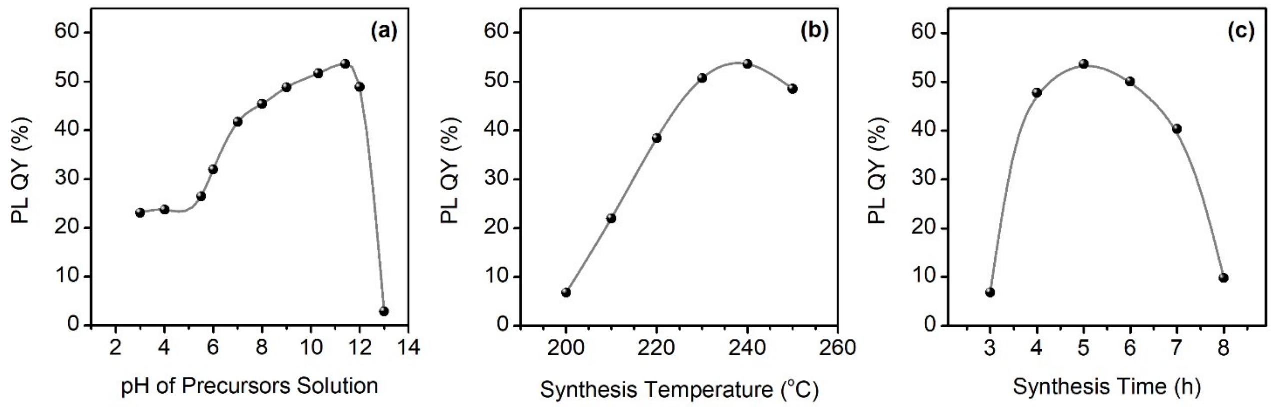

Fig. S1 Optimization of the synthesis conditions for preparation of p-CDs. (a) PL quantum yield measured for the different pH of the precursor solution used for the synthesis. (b) PL quantum yield measured for different temperature reactions. (c) PL quantum yield measured for the different synthesis duration.

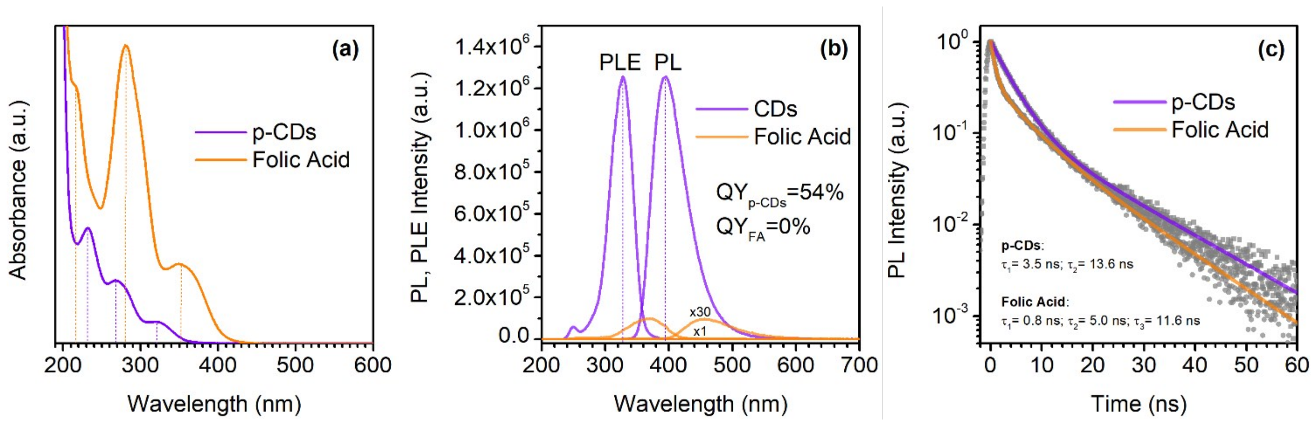

Fig. S2 Optical properties of folic acid compared to p-CDs. (a) Absorption spectra, (b) PL and PL excitation spectra (PL and PLE spectra for folic acid are given with ×1 and ×30 scaling), (c) PL decay spectra (experimental data are represented by symbols, whereas lines are the multiexponential fits).

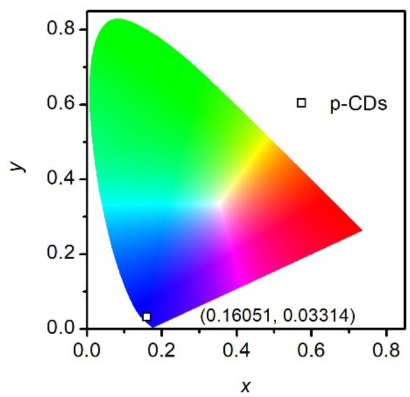

Fig. S3 CIE 1931 chromaticity diagram showing the emission color coordinates of p-CDs dispersed in water.

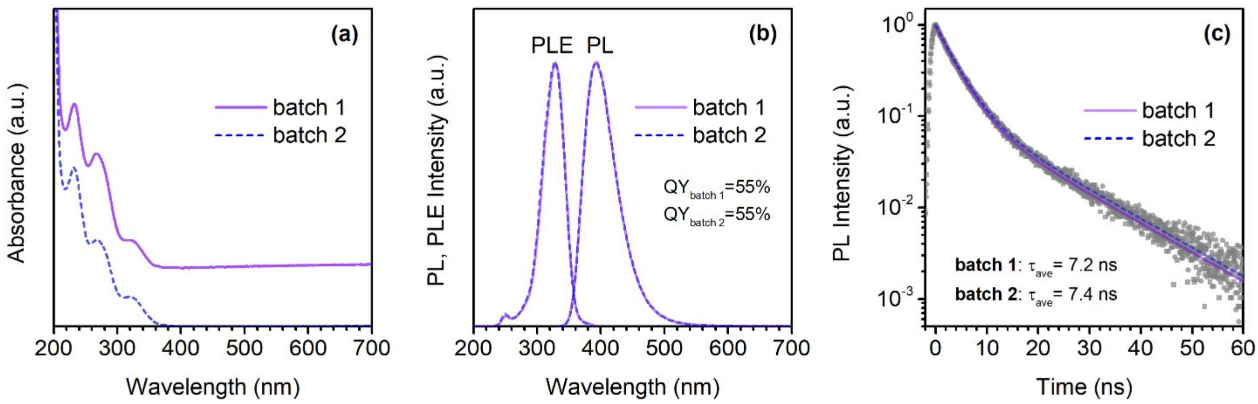

Fig. S4 Reproducibility of p-CDs synthesis. (a) Absorption spectra, (b) PL excitation and PL emission spectra, (c) PL decays of two batches of p-CDs.

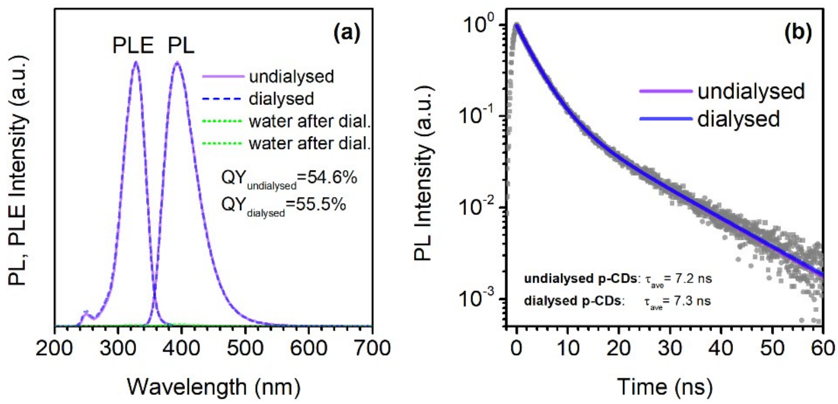

Fig. S5 Optical properties of p-CDs sample before and after dialysis, as well as water collected after dialysis. (a) PL and PLE spectra of p-CDs before dialysis (solid line), p-CDs after dialysis (dashed line), and water collected after dialysis (dotted line). (b) PL decays of p-CDs before and after dialysis with corresponding extracted average PL lifetimes.

Time-resolved photoluminescence (TR PL) measurements

The PL decay curves were fitted using a multi-exponential function:

$$I(t) = \sum_{i=1}^{n} B_i exp(-t/\tau_i), \qquad \sum_{i=1}^{n} B_i = 1 \tag{1}$$

In this expression τ_i represent the decay time constants, and B_i represents the normalized amplitudes of each of the components, n is the number of decay times.

Because the PL decays for p-CDs are best fitted using a two-exponential model (n = 2), the amplitude weighted average lifetime of the entire fluorescence decay process was calculated with the form:

$$\tau_{avg} = \frac{B_1\tau_1^2 + B_2\tau_2^2}{B_1\tau_1 + B_2\tau_2} \tag{2}$$

The PL decay fitting data for all curves are summarized in Table S1.

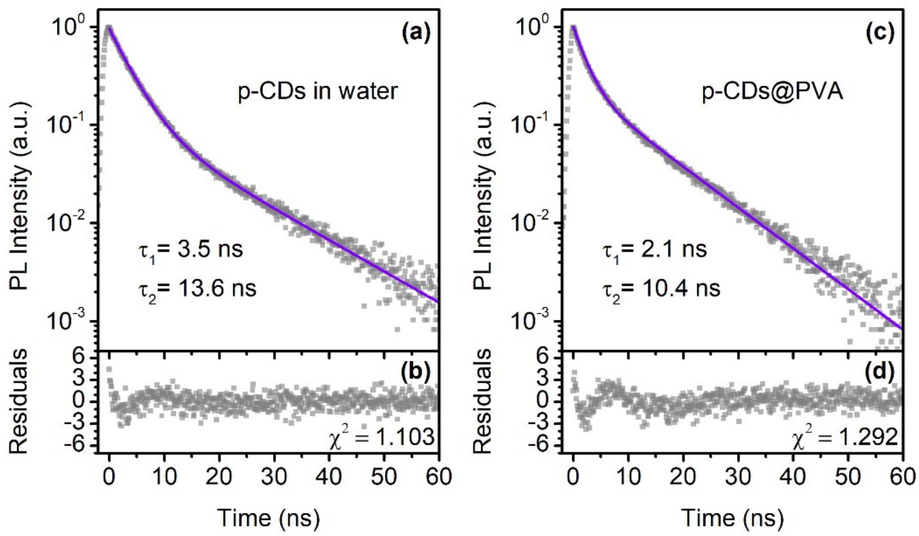

Fig. S6 PL decays of p-CDs in water (a) and p-CDs@PVA (c) collected at the emission maximum. Experimental data are represented by symbols, whereas solid line is two-exponential fit. (b,d) The weighted residuals and the reduced χ^2 values for two-exponential fits of the PL decays from (a) and (c).

Table S1 The fitting parameters of the corresponding normalized photoluminescence decay curves.

Sample	λ_{em}, nm	B_1, %	f_1, %	τ_1, ns	B_2, %	f_2, %	τ_2, ns	τ_{avg}, ns	χ^2
p-CDs in water	393	87.0	63.3	3.506	13.0	36.7	13.629	7.226	1.103
p-CDs@PVA	389	75.1	38.2	2.134	24.9	61.8	10.440	7.268	1.292

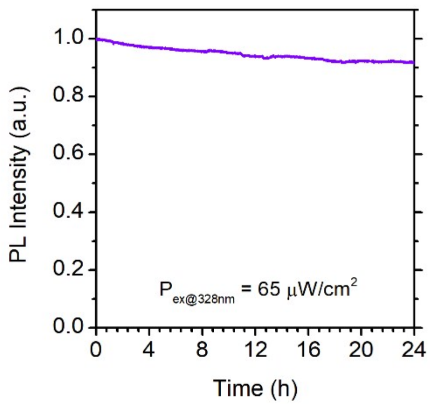

Fig. S7 Photostability of p-CDs@PVA layer continuously irradiated with λ_{ex} = 328 nm and P = 65 μW/cm^2.

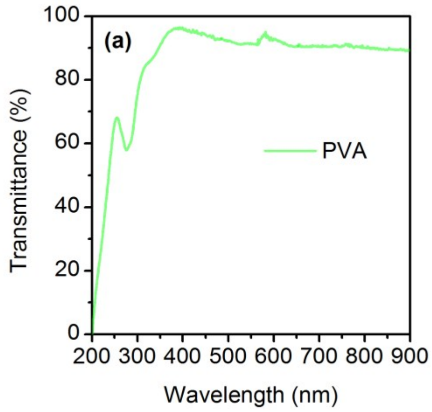

Fig. S8 Transmission spectrum of ~100 μm PVA layer.

Author Contributions

S. K. synthesized the samples, conceived and designed the experiments. L. Z. performed optical characterizations. M. S. performed AFM characterization. R. Z. designed and supervised this study. S. K. and R. Z. wrote the manuscript. All authors commented on the manuscript.