Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

One-step synthesis of room-temperature-phosphorescent carbon dots and their application as security ink

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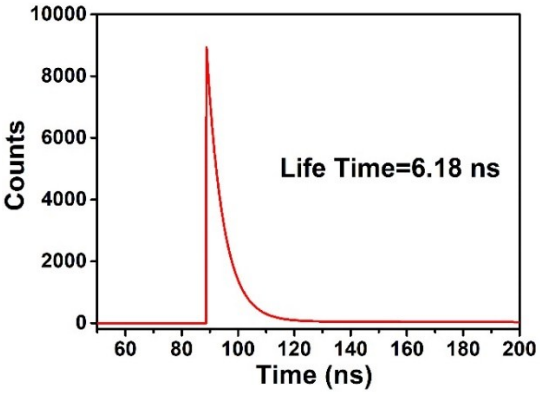

Figure S1 The lifetime of NCDs solution.

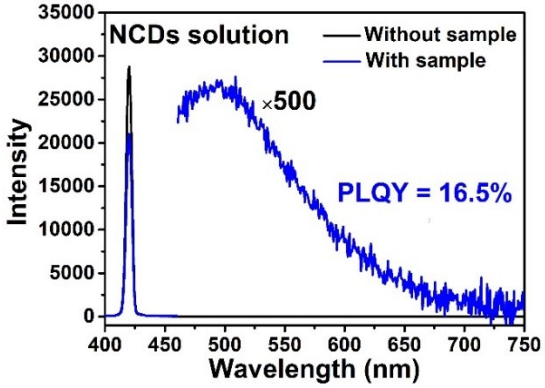

Figure S2 The fluorescence quantum yield of NCDs solution.

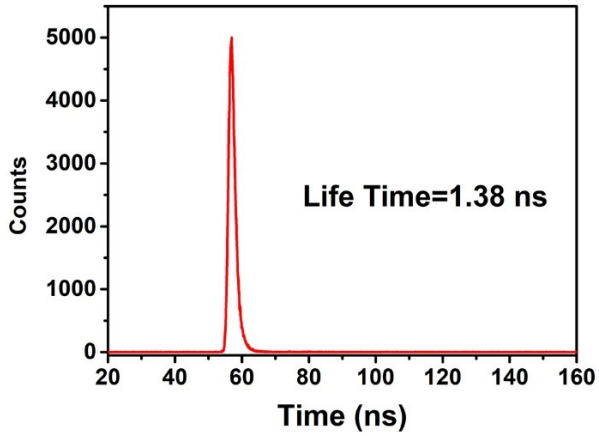

Figure S3 The lifetime of NCDs powder.

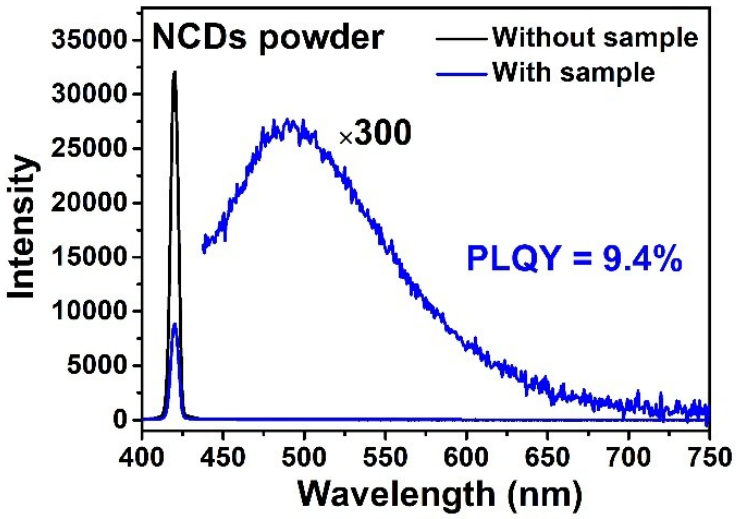

Figure S4 The fluorescence quantum yield of NCDs powder.

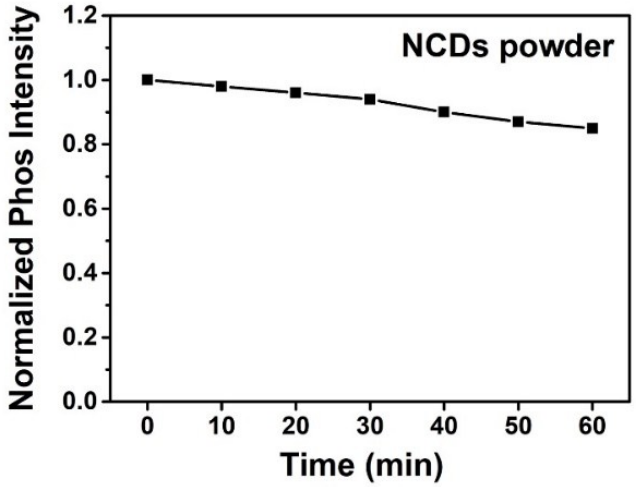

Figure S5 Phosphorescence intensities of the NCDs powder during continuous excitation with a UV beam (λ_{ex} = 365 nm). Irradiation time: 0 to 60 min.

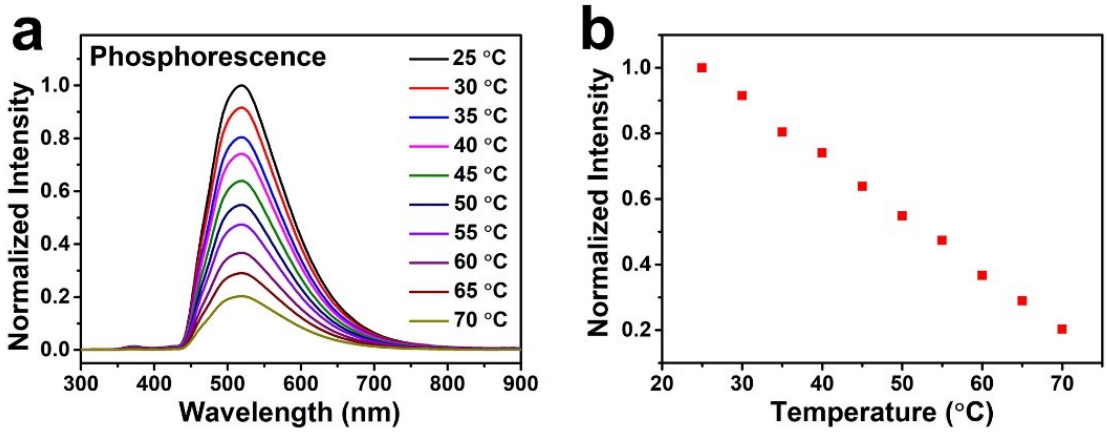

Figure S6 (a) Phosphorescence spectra of NCDs powder at different temperatures from 20 to 70 °C (λ_{ex} = 365 nm). (b) their variation of intensity versus temperature.

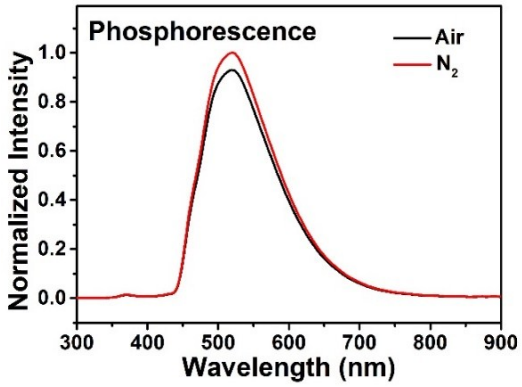

Figure S7 Phosphorescence emission spectra of NCDs powder in air and N_2 (λ_{ex} = 365 nm).

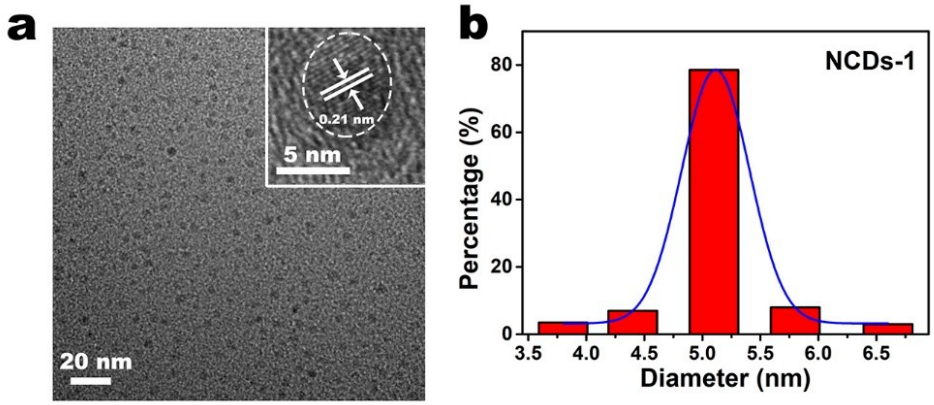

Figure S8 (a) The TEM image of NCDs-1. (b) The size distribution of NCDs-1 (columns) and distribution curve (solid line). The Figure S9 indicate that the as-prepared NCDs-1 has well dispersed and their average size is 5 nm.

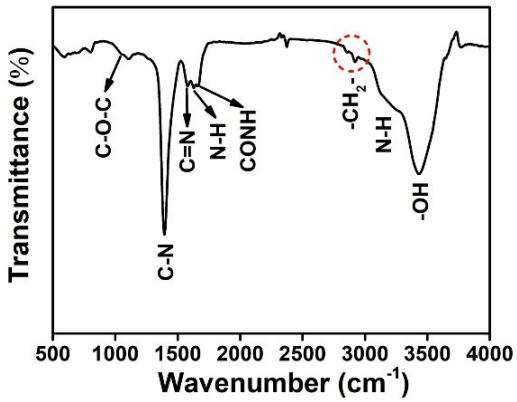

Figure S9 The FTIR spectra of NCDs-1. The peaks centered around 3433 cm^{-1} and around 3190 $cm^{-1}$are the absorption of –OH stretching vibration and $–NH_2$ stretching vibration, respectively. The methylene ($–CH_2–$) asymmetric and symmetric stretching frequencies locate at 2976 and 2920 cm^{-1}in the FTIR spectrum, respectively. The absorption peak at 1664 cm^{-1} correspond to C=O stretch of the amide bond and carboxyl. The peaks observed at 1630, 1578 and 1394 cm^{-1} are assigned to the bending vibration of N–H, the stretching vibration of C=N and C–N bending modes, respectively. The peak at 1053 cm^{-1} corresponds to the symmetric stretching vibrations of C–O–C.

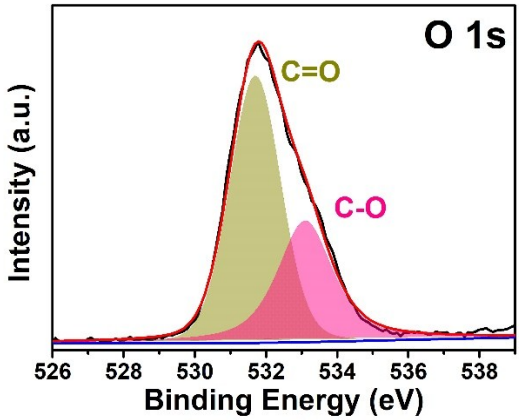

Figure S10 (a) High-resolution O 1s XPS spectra of NCDs-1. The figure S11 shown the High-resolution O 1s XPS spectra of NCDs-1, The wide O 1s core level peak exhibits two main peaks, they located at 531.7 and 533.1 eV to the C=O and C–O bonds.

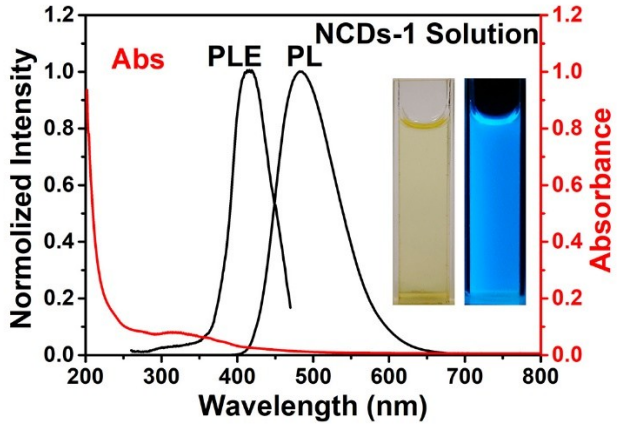

Figure S11 The UV-Vis absorbance (red line), PL excitation (PLE: λ_{ex} = 416 nm) and emission (PL: λ_{em} = 484 nm) spectra of NCDs-1 solution (inset: NCDs-1 solution under daylight and UV lamp (365 nm))

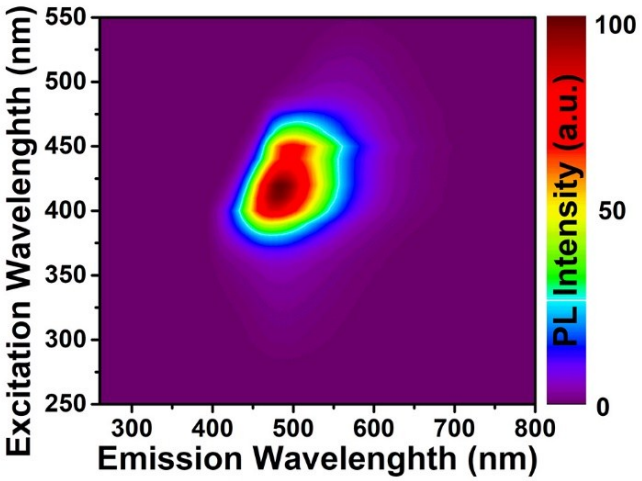

Figure S12 Excitation–emission color map of NCDs-1 solution.

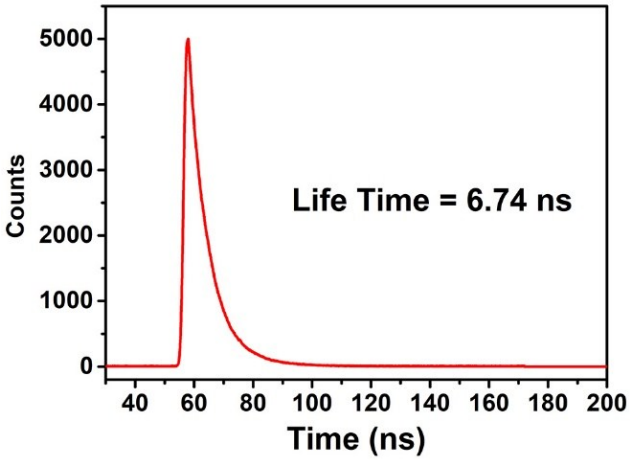

Figure S13 The lifetime of NCDs-1 solution.

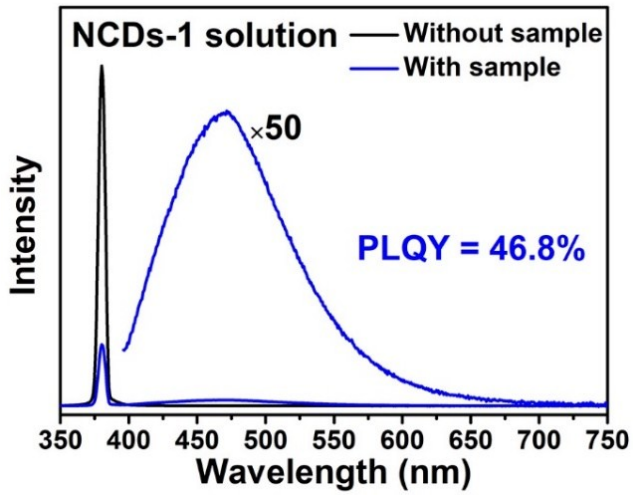

Figure S14 The fluorescence quantum yield of NCDs-1 solution.

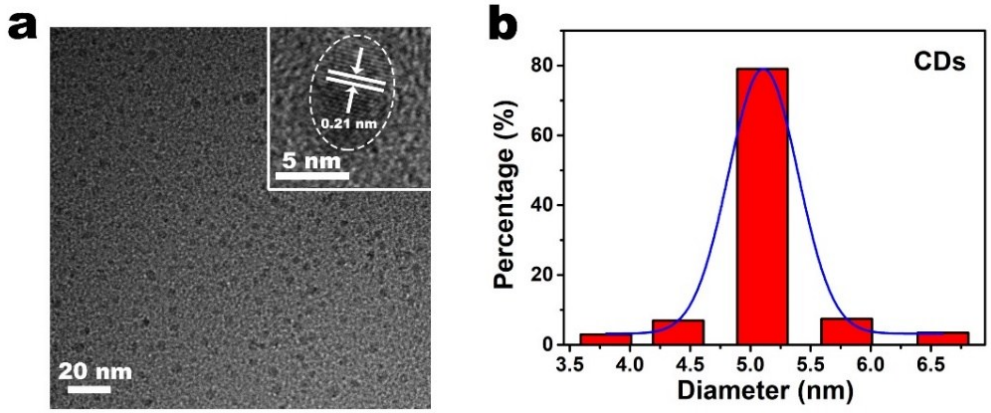

Figure S15 (a) The TEM image of CDs. (b) The size distribution of CDs (columns) and distribution curve (solid line). The experiment data indicate that the as-prepared CDs has well dispersed and their average size is 5 nm.

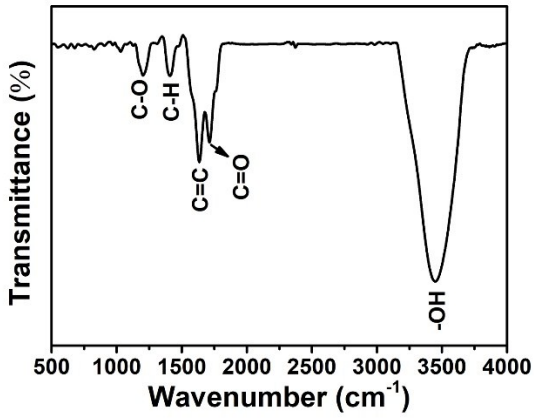

Figure S16 The FTIR spectra of CDs. The peaks centered around 3447 cm^{-1} is the absorption of –OH stretching vibration. The C=O stretching vibration and C=C locate at 1714 and 1637 cm^{-1}in the FTIR spectrum, respectively. The absorption peak at 1409 cm^{-1} correspond to deformation vibration of C–H. The peak observed at 1203 cm^{-1} is assigned to the stretching vibration of C–O.

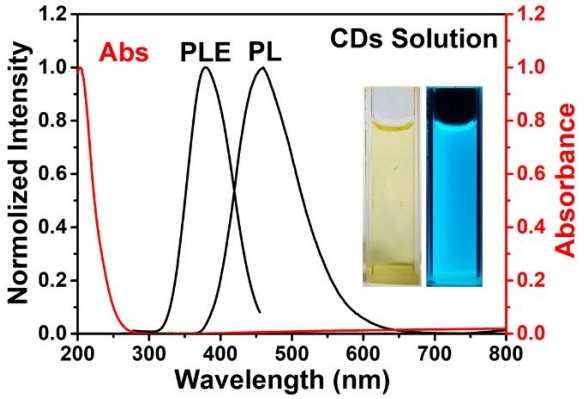

Figure S17 The UV-Vis absorbance (red line), PL excitation (PLE: λ_{ex} = 380 nm) and emission (PL: λ_{em} = 460 nm) spectra of CDs solution (inset: CDs solution under daylight and UV lamp (365 nm))

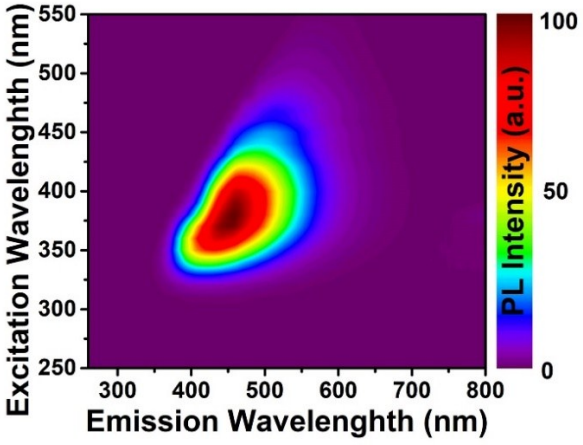

Figure S18 Excitation–emission color map of CDs solution.

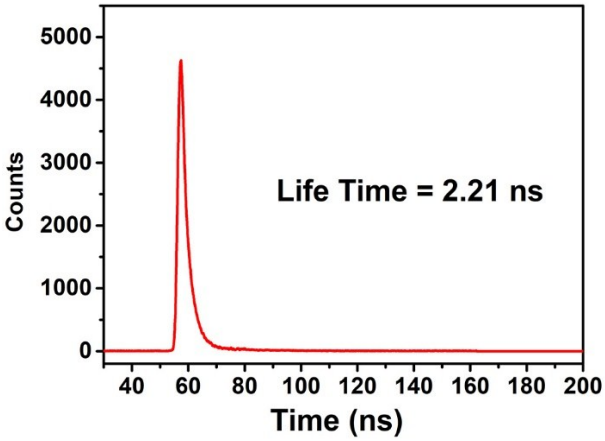

Figure S19 The lifetime of CDs solution.

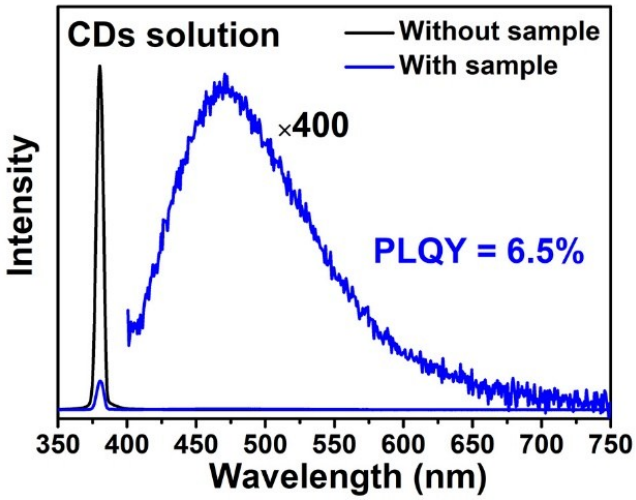

Figure S20 The fluorescence quantum yield of CDs solution.

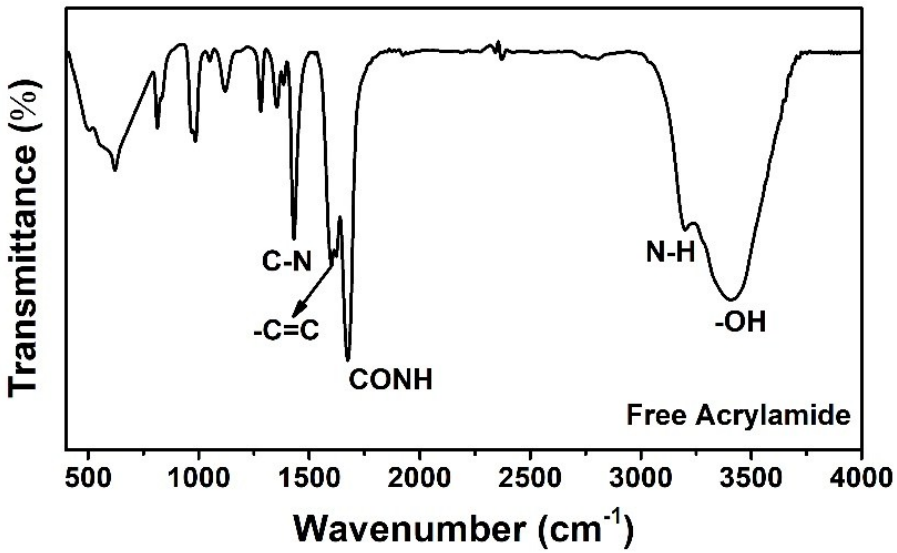

Figure S21 FTIR spectra of the free acrylamide.