Electronic Supplementary Information

Towards efficient solid-state photoluminescence based on carbon-nanodots and starch composites

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Characterization

The UV-Vis absorption spectrum of CDs in water was recorded on a UV-3101PC UV-Vis-NIR scanning spectrophotometer (Shimadzu). The PL spectra were recorded by a Hitachi F-7000 spectrophotometer and the PL QYs of starch/CD phosphors were measured by this spectrophotometer with an integrating sphere. The diffuse reflectance spectra were also measured by Hitachi F-7000 spectrophotometer with an integrating sphere scanning from 200-700 nm with $BaSO_4$ as the reference. The fluorescence images of the starch/CD phosphors were taken by Nikon C2 Confocal Microscopy. The time-resolved PL spectra were measured by a LifeSpec-II dedicated lifetime spectrometer (Edinburgh Instruments). The excitation source was picosecond pulsed diode laser with a laser wavelength of 405 nm. The photostability of the starch/g-CD phosphors (mass ratio: 45:1) and commercial fluorescent dye ink was tested under a 500 W xenon-mercury lamp at a 10 cm distance at the same condition. For the temperature-dependent PL measurement, the starch/CD phosphors (mass ratio: 70:1) were mounted in a micro-objective cryostat with a controllable temperature range from 80 to 370 K. The temperature-dependent PL spectra were measured by a Jobin-Yvon Si-CCD excited by a 405 nm laser light source. The CIE chromaticity coordinates and correlated color temperatures (CCT) of the starch/CD phosphor-based LEDs were measured by PR-705 spectra scan spectroradiometer at room temperature.

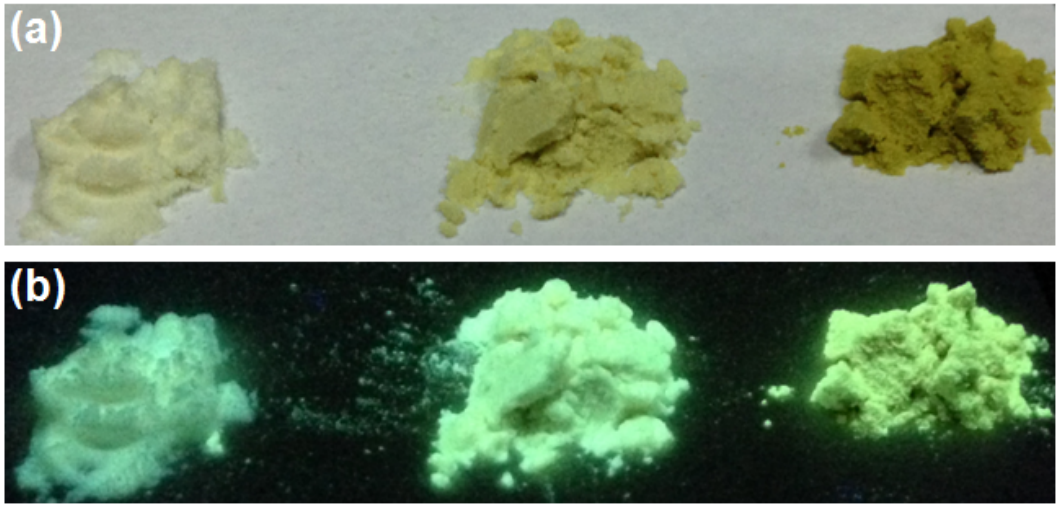

Fig. S1 Optical images of the starch/g-CD phosphors with different g-CD contents (mass ratio: 450:1, 70:1, 20:1 from left to right).

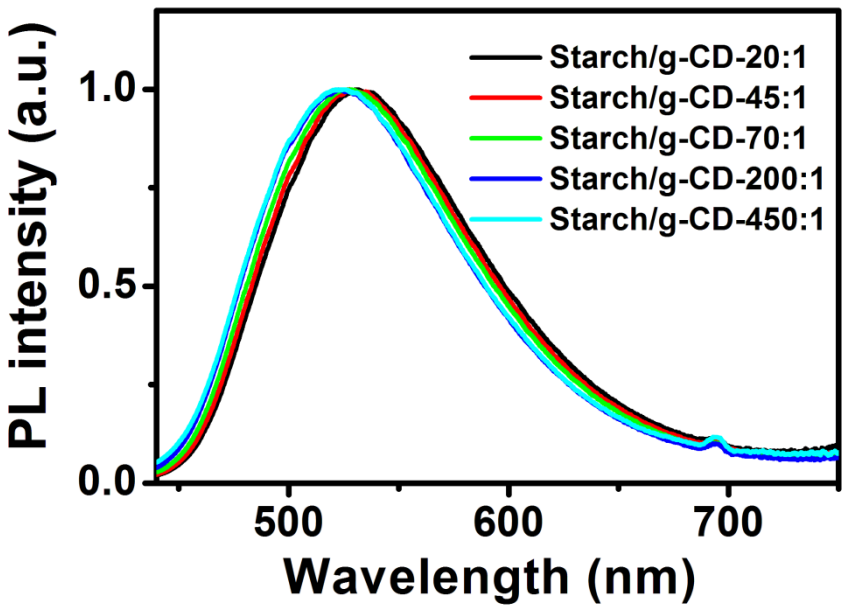

Fig. S2 Normalized PL spectra of the starch/g-CD phosphors with different g-CD contents (excitation at 420 nm).

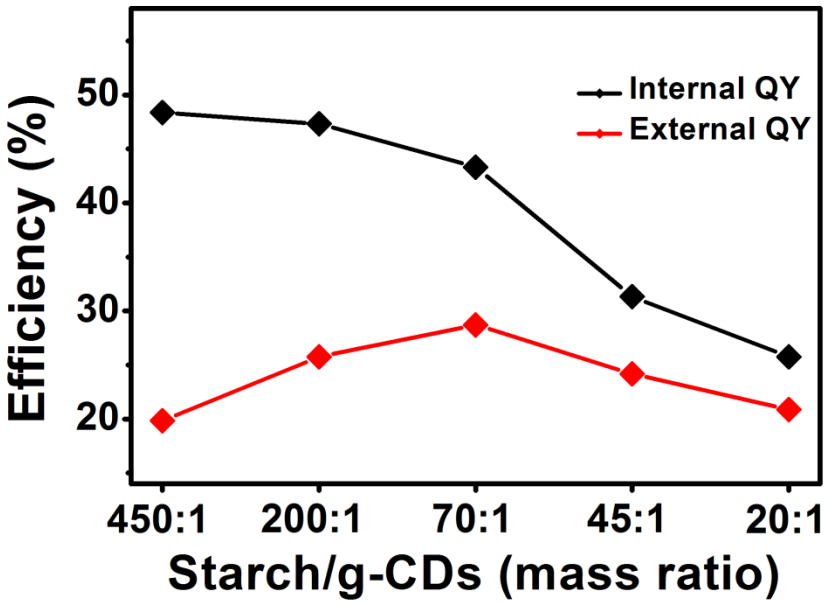

Fig. S3 PL QYs of starch/g-CD phosphors with different g-CD coverage degrees (excitation at 450 nm).

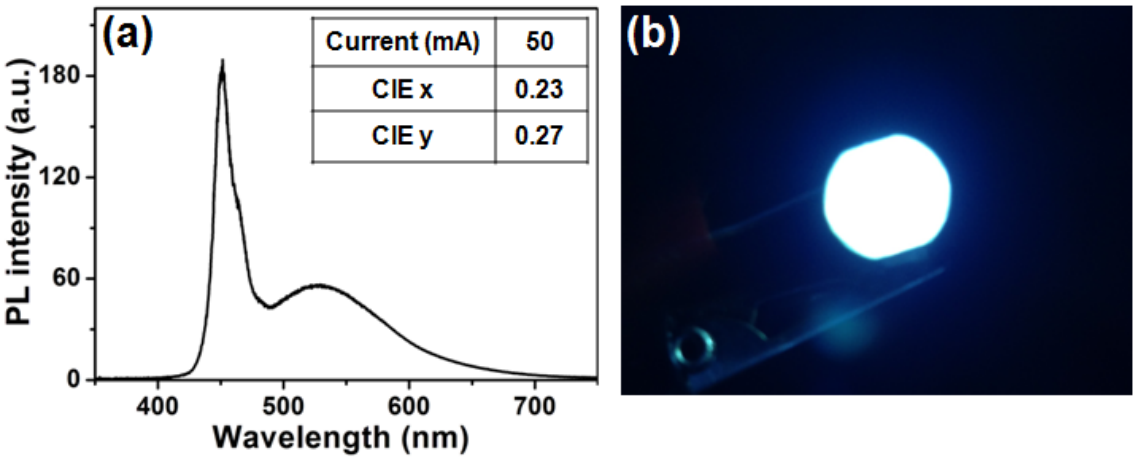

Fig. S4 (a) Emission spectrum of the starch/g-CD phosphor-based (mass ratio: 70:1) LEDs. (b) Optical image of the corresponding LEDs at the current of 50 mA.

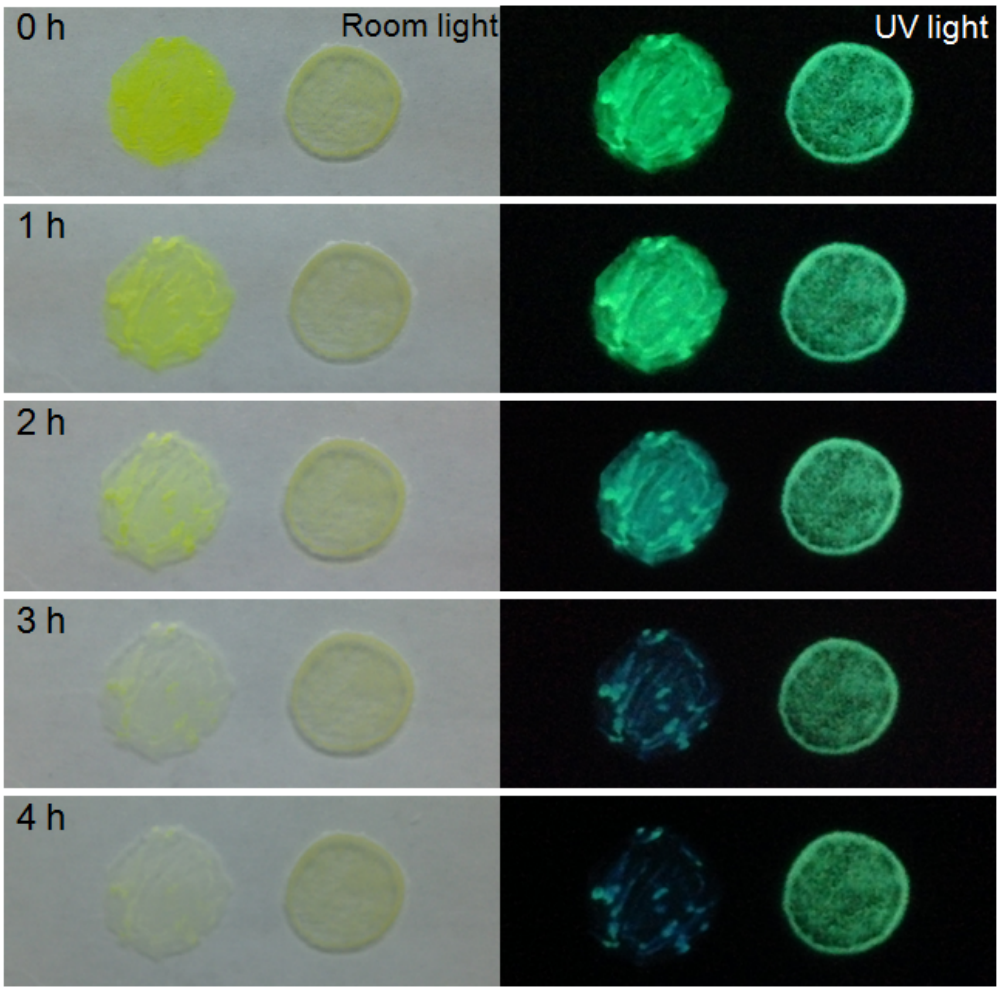

Fig. S5 Optical images of the commercial fluorescent dye ink (the first and third columns) and starch/g-CD phosphors (mass ratio 45:1) (the second and fourth columns) deposited on glass substrates exposed under 500 W xenon-mercury lamp for different time.

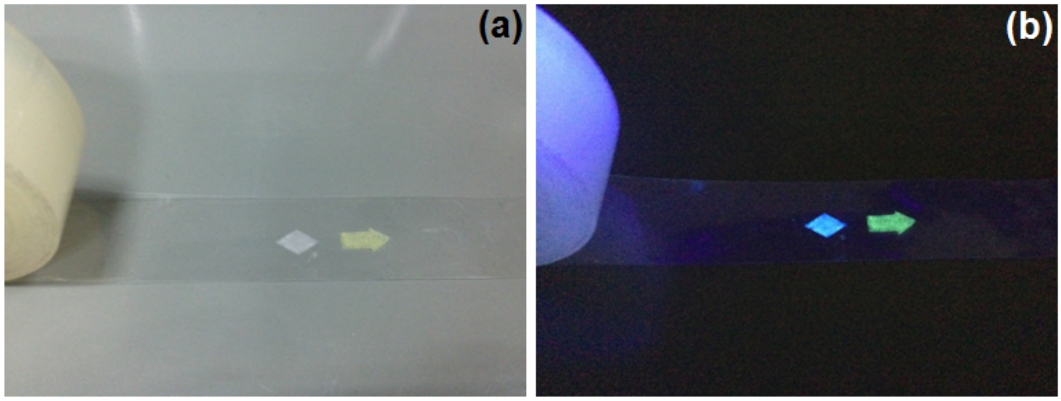

Fig. S6 Optical images of the patterns composed by blue or green luminescent phosphors in specific shapes on transparent tape under room light (a) and UV excitation (b).

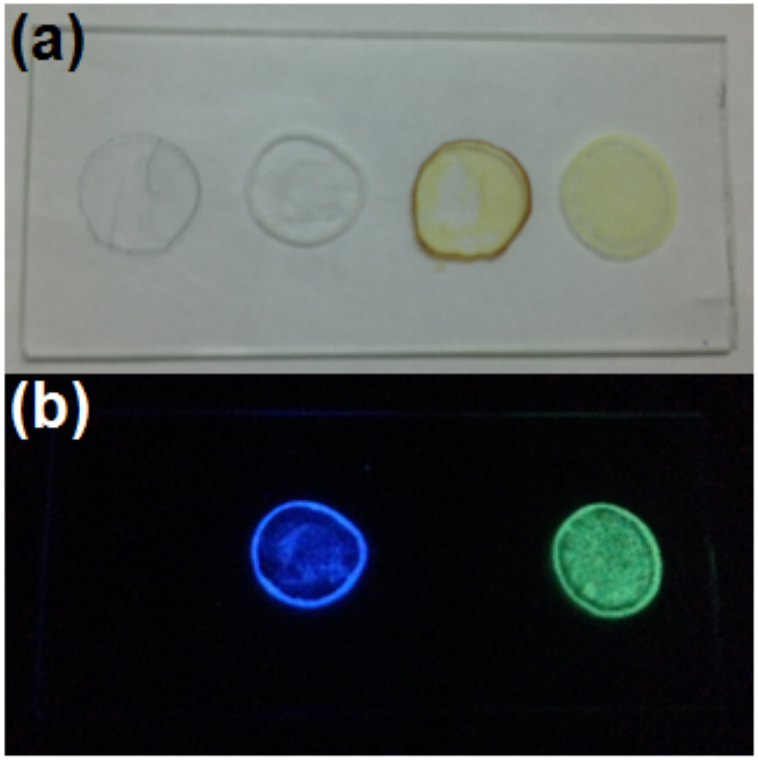

Fig. S7 Optical and fluorescent images of b-CDs and g-CDs deposited on glass substrates from their water solutions, and starch/b-CD and starch/g-CD phosphors deposited on glass substrates from their chloroform suspensions (from left to right) under room light (a) and UV lamp (b).

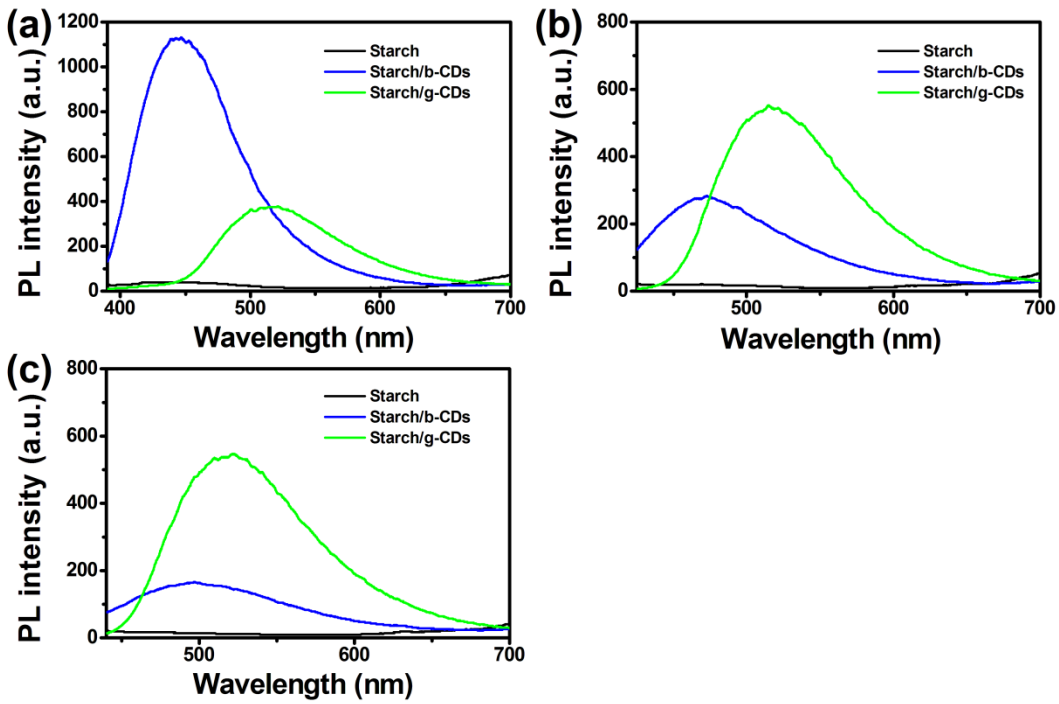

Fig. S8 The PL spectra of starch, starch/b-CD phosphors, and starch/g-CD phosphors with excitation at 365 (a), 405 (b), and 420 (c) nm.

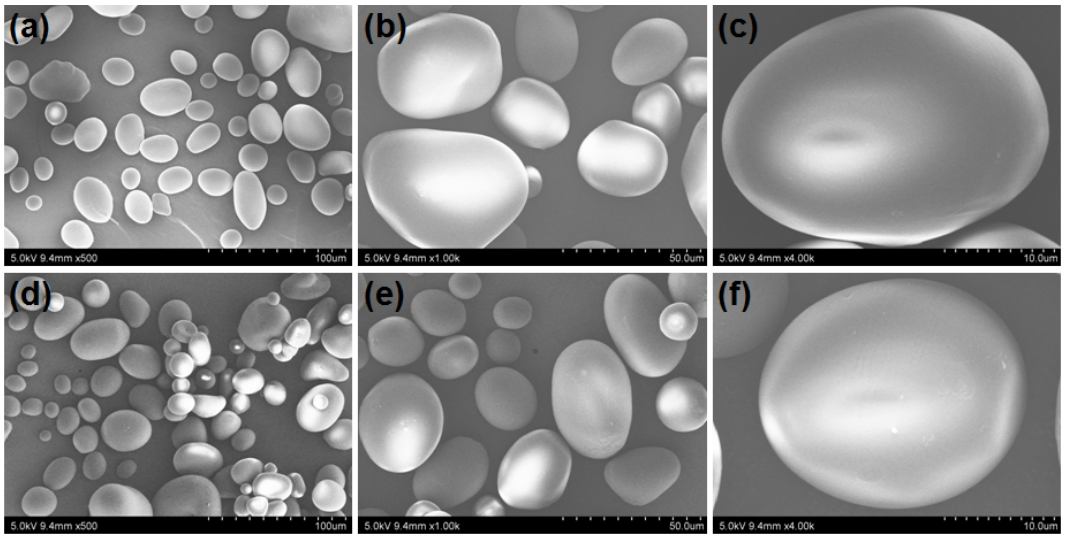

Fig. S9 The SEM images of starch/b-CD (a-c) and starch/g-CD (d-f) phosphors.

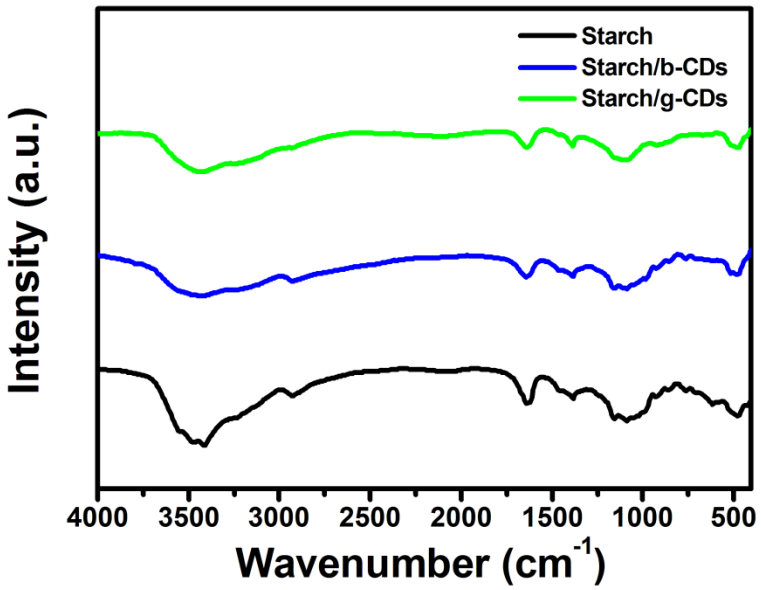

Fig. S10 The FTIR spectra of starch, starch/b-CD phosphors, and starch/g-CD phosphors.