Reversible On/Off Switching of fluorescence via esterification of carbon dots

Upama Baruah,[a] Manash Jyoti Deka[a] and Devasish Chowdhury*[a]

ELECTRONIC SUPPLEMENTARY INFORMATION

Elemental analysis of pure citric acid and that of CDs obtained from citric acid (before being dispersed in NaOH) was carried out. Table S1 shows the weight percentage of carbon and oxygen obtained from elemental analysis of citric acid before and after pyrolysis to form CDs.

Sample	C (weight %)	O (weight %)
Citric acid	21.2 ± 1.5	78.7 ± 1.5
CDs	41.7 ± 1.2	57.9 ± 1.1

Table S1. Elemental analysis results of citric acid before pyrolysis and CDs obtained from citric acid (before being dispersed in NaOH).

From the above table it is clear that the carbon content of CDs is higher than that of citric acid which implies that citric acid is carbonized during pyrolysis.

Powder X-ray diffraction analysis was performed on both citric acid and CDs. Figure S1 shows the stacked powder XRD diffractogram of pure citric acid and that after pyrolysis to form CDs. The XRD pattern of pure citric acid showed well-defined and sharp peaks whereas after pyrolysis to form CDs the spectrum shows a broad peak suggesting that citric acid has been carbonized to form amorphous carbon dots.

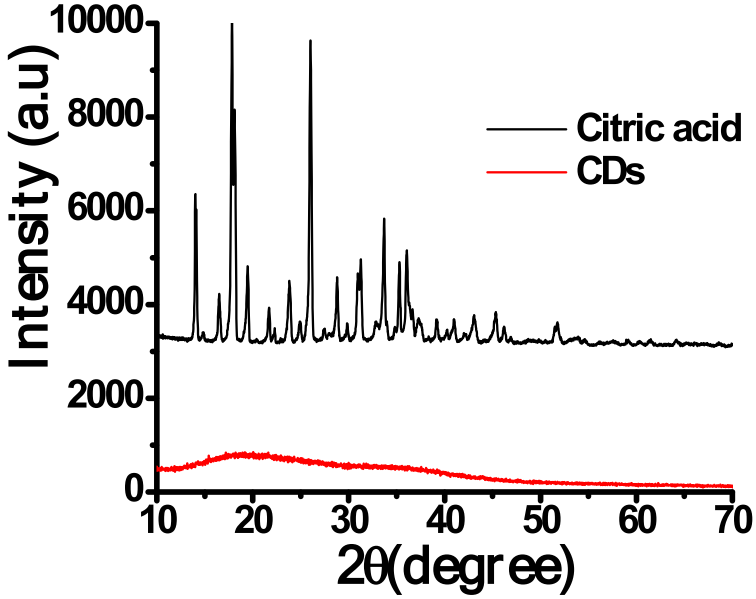


Figure S1. Stacked powder XRD spectra of pure citric acid and that after pyrolysis to form CDs.

The PL emission spectrum of CDs was recorded at pH 12 and it was observed that at this pH the CDs exhibit excitation-independent emission property (Figure S2 A). From the comparison plot of PL intensities of CDs as shown in figure S2 (B) it is evident that for an excitation wavelength of 380 nm the CDs exhibit maximum intensity at pH 7.

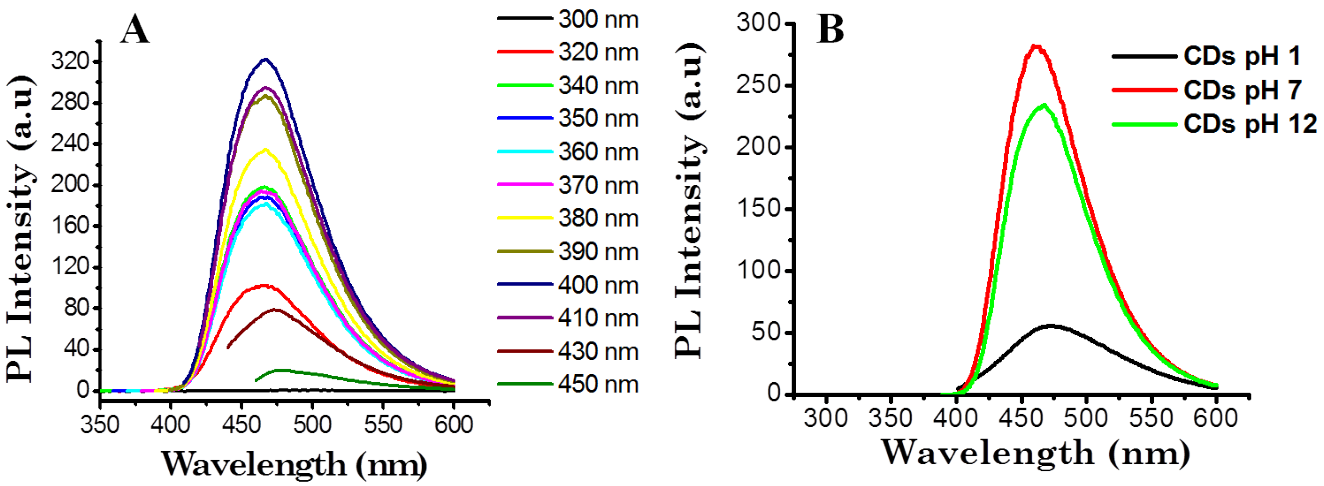


Figure S2. (A) Stacked photoluminescence spectra of CDs at pH 12 showing excitation-independent emission property. (B) Comparison of PL intensities of CDs at pH 1, 7 and 12 at an excitation wavelength of 380 nm.

The PL excitation and emission spectra for CDs and CDs-PEG-ES were recorded at both the pH. The PL spectra showing the excitation and emission PL intensities and the respective blue and red shifts of CDs after esterification at pH 1 and 7 are shown in figure S3.

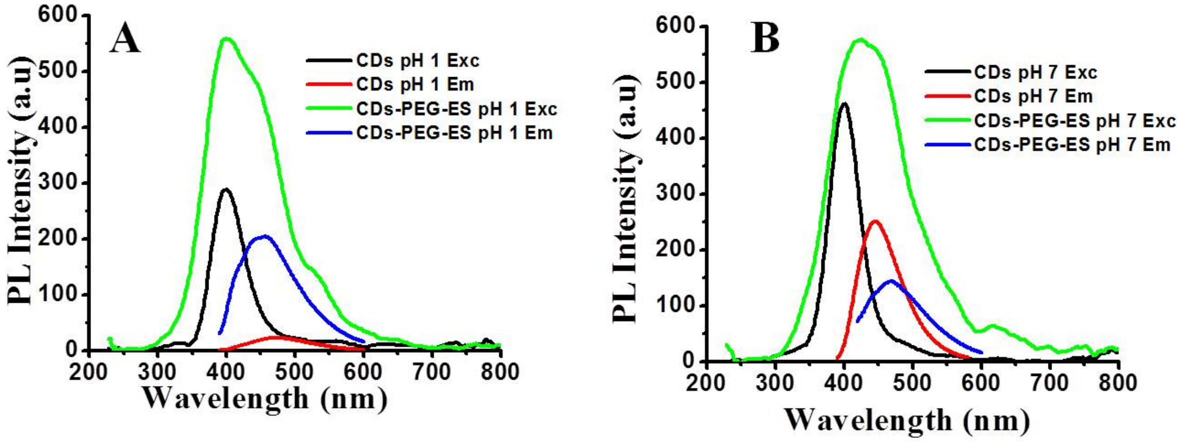
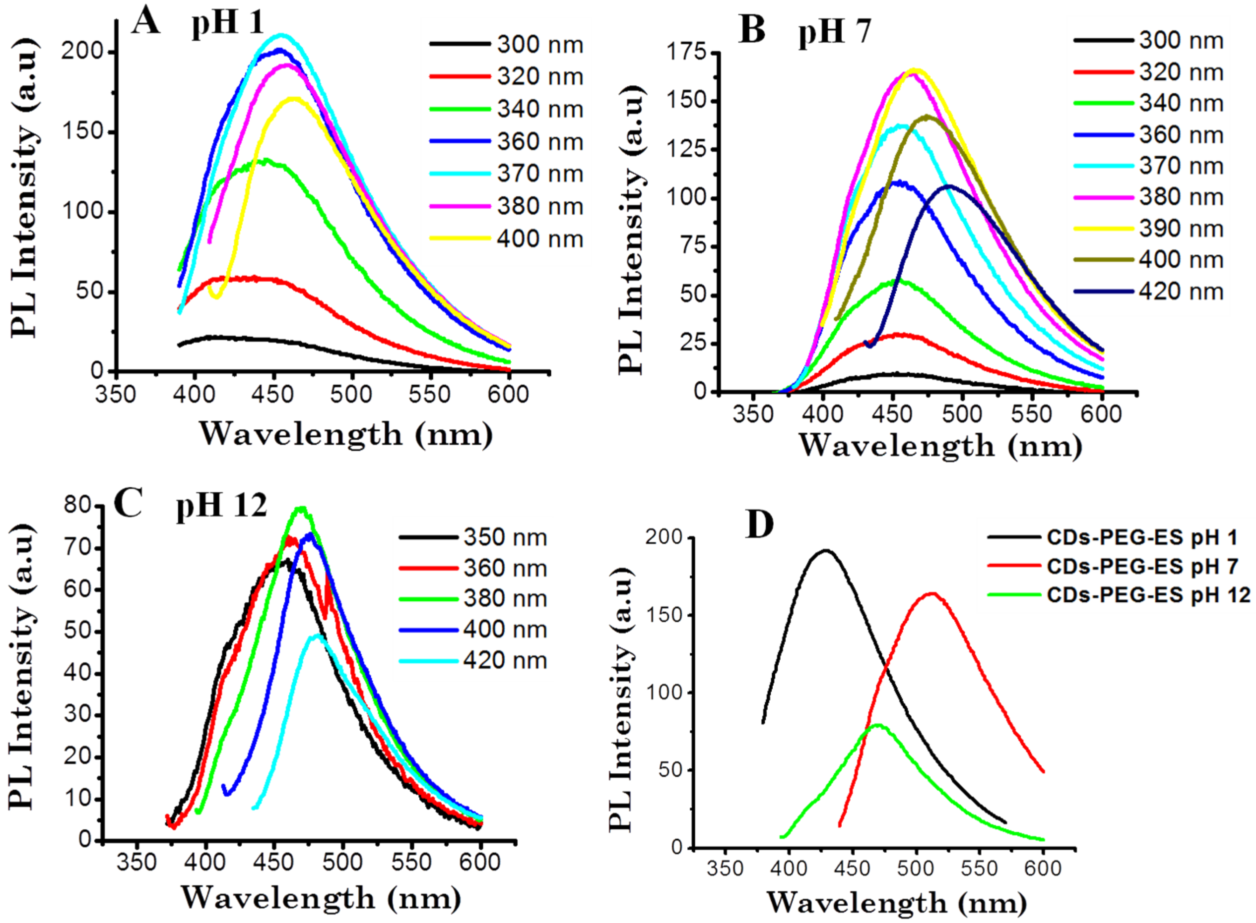


Figure S3. The PL excitation and emission spectra for CDs and CDs-PEG-ES at (A) pH 1 and (B) pH 7.

The PL emission spectrum of the CDs after esterification was recorded at all pH viz. 1, 7 and 12. The stacked PL emission spectra of CDs esterified with poly(ethylene glycol) i.e., CDs-PEG-ES at pH 1, 7 and 12 are shown in figure S4 (A), (B) and (C) respectively. Furthermore, the



comparison of PL intensities of CDs-PEG-ES at all the three pH at an excitation wavelength of 380 nm is shown in figure S4 (D).

Figure S4. The stacked PL emission spectra of CDs esterified with poly(ethylene glycol) i.e., CDs-PEG-ES at (A) pH 1, (B) 7 and (C) 12. (D) Comparison of PL intensities of PEG-ES at all the three pH at an excitation wavelength of 380 nm.

In all the cases it was observed that the esterified CDs exhibit excitation-dependent emission behavior. Further, it is quite evident from figure S4 (D) that the PL intensity of CDs esterified with poly(ethylene glycol) is maximum at pH 1 at an excitation wavelength of 380 nm. However the emission was determined to be pH dependent.