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

(Supporting Information)

Multicolour Light Emission from Chlorine-Doped Graphene Quantum Dots

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1. Chemicals

Fructose (≥99%) was purchased from Sigma-Aldrich. Hydrochloric acid (32% *wt*.) was purchased from International Laboratory, USA. These chemicals were used to prepare Cl-GQDs without further purifying.

2. Supplementary Figures

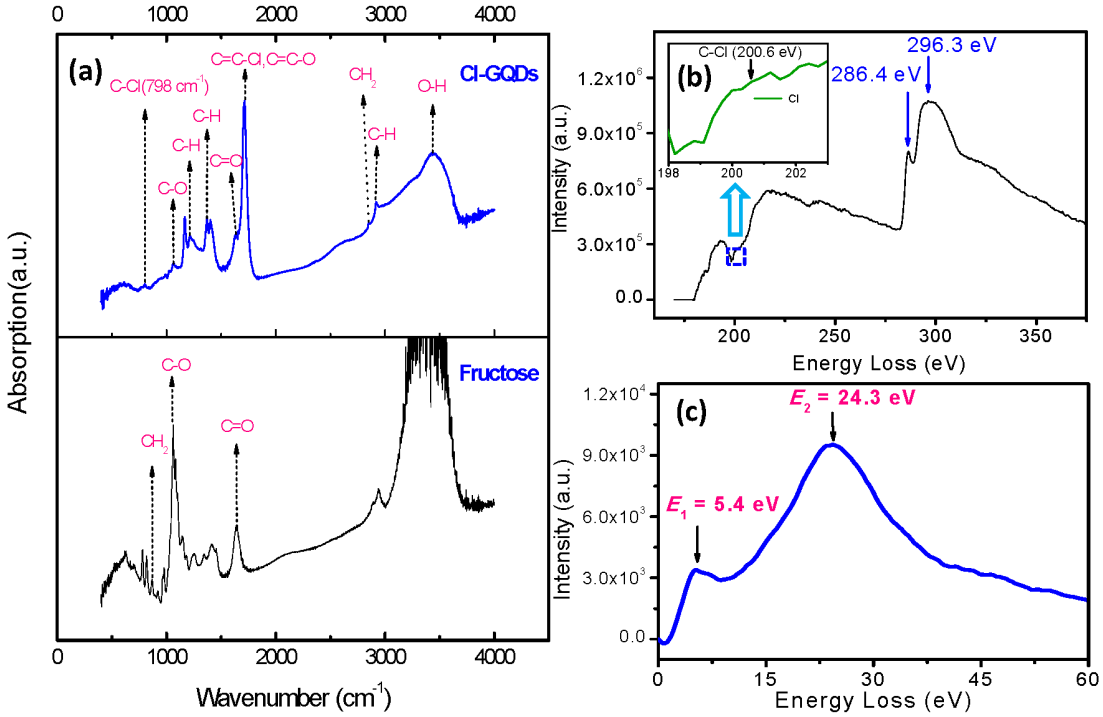

Figure S1. (a) The FTIR spectra of the Cl-GQDs (top) and its source fructose (bottom). (b) EELS spectrum of the Cl-GQDs (C K-edge spectrum). The inset is Cl L2,3 edge spectrum. (c) Low-loss EELS spectrum of the Cl-GQDs.

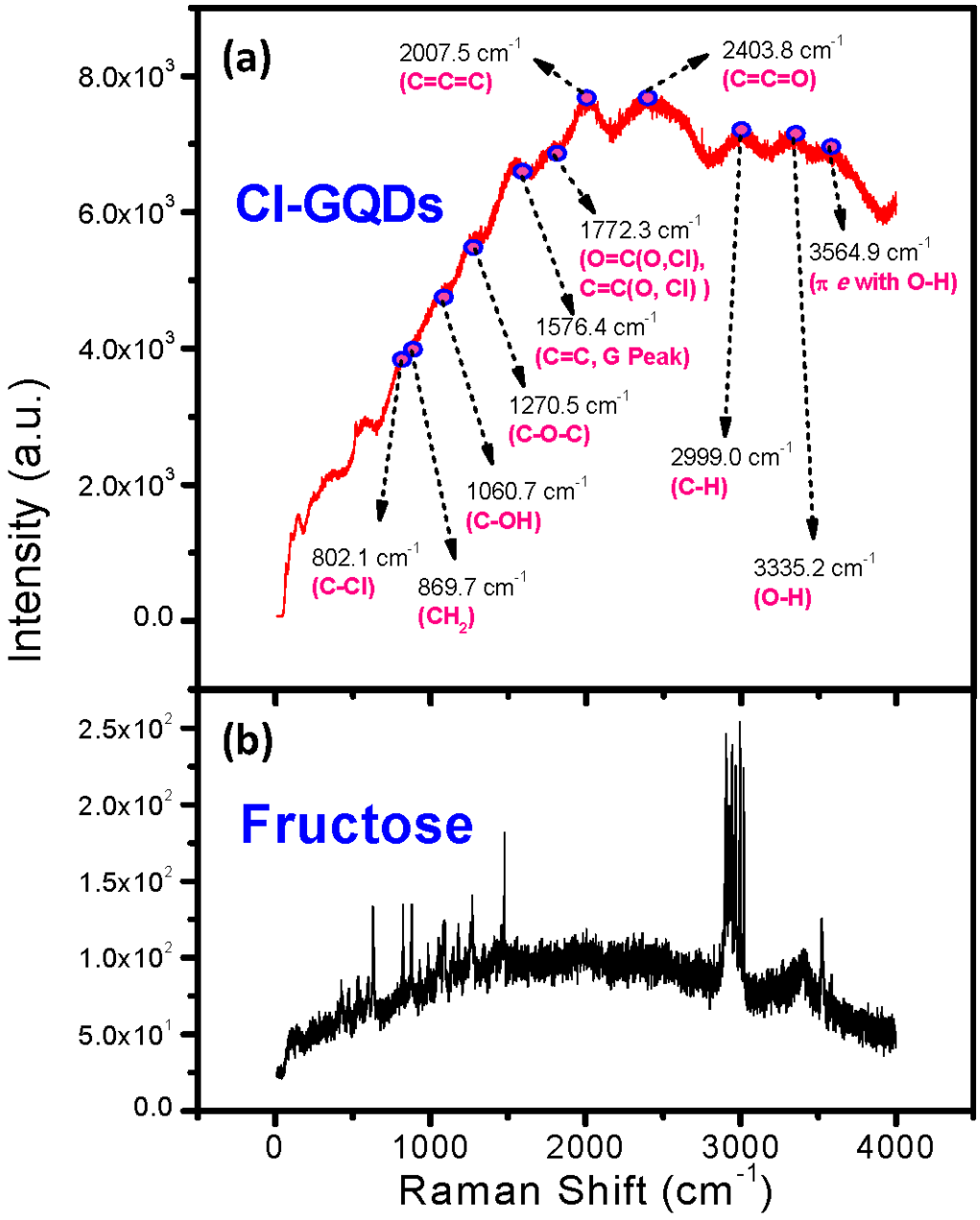

Figure S2. The Raman spectra of the (a) Cl-GQDs and (b) source fructose.

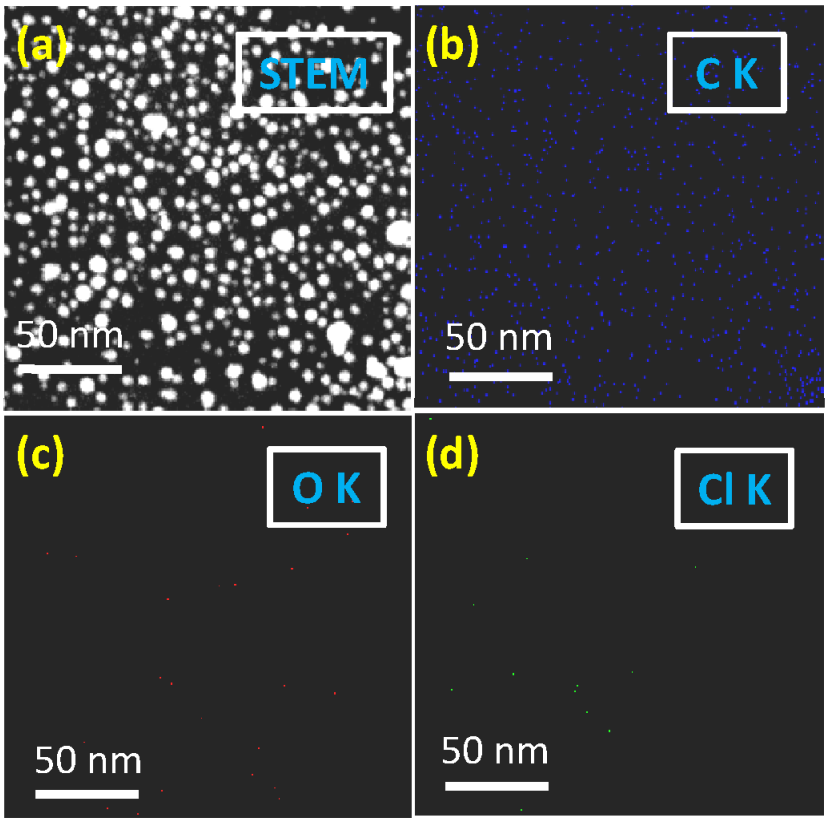

Figure S3. (a) STEM image of the Cl-GQDs assembled on Cu grid coated with ultrathin amorphous carbon film. (b) Elemental C mapping (in blue) of the image shown in panel (a). (c) Elemental O mapping (in red) of the image shown in panel (a). (d) Elemental Cl mapping (in green) of the image shown in panel (a).

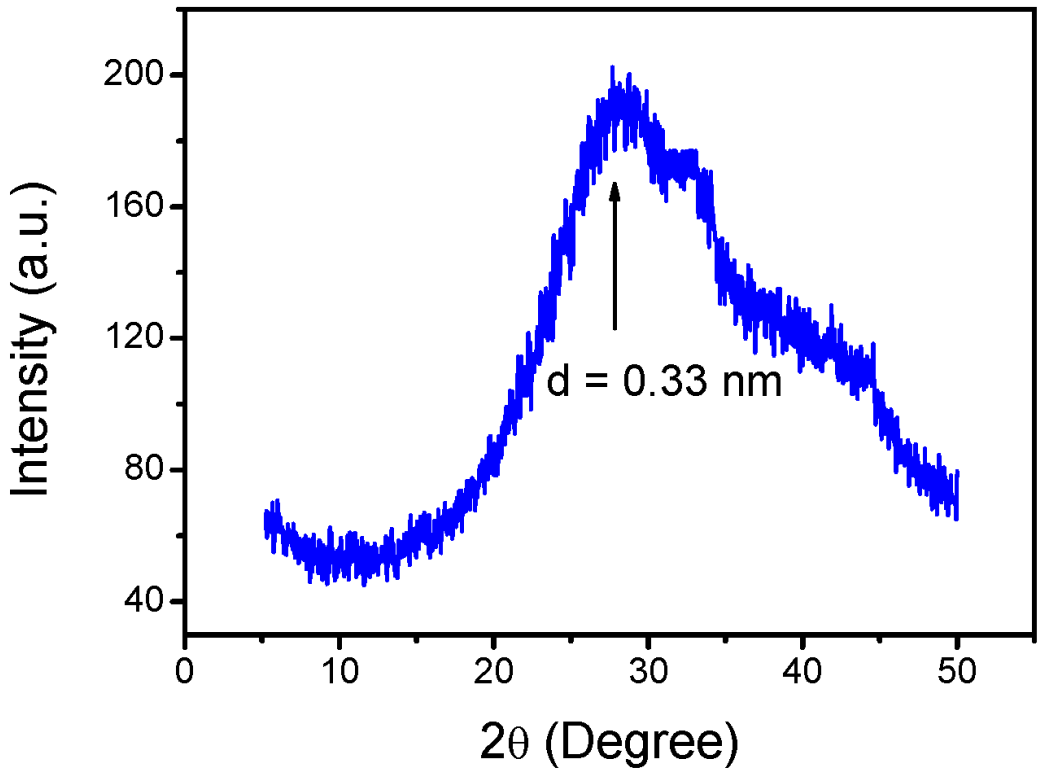

Figure S4. The XRD diffraction pattern of the Cl-GQDs.

Figure S5. The photograph of the Cl-GQDs excited by a wavelength of 600 nm. The inset is the corresponding colour of the excited light.

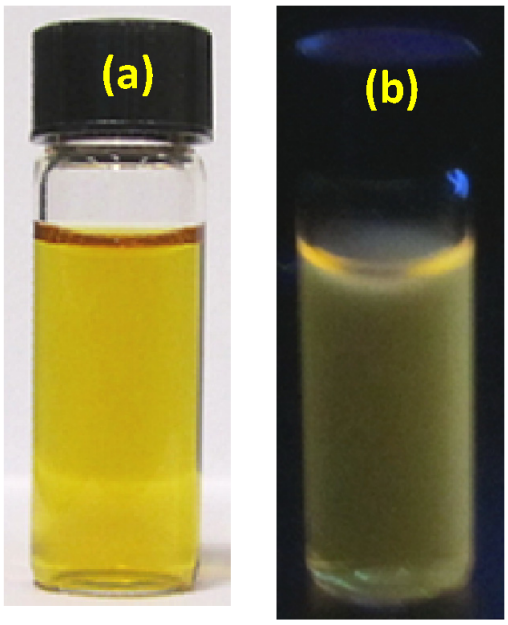

Figure S6. The photographs of the Cl-GQD solution irradiated by (a) ambient light and (b) 365 nm UV lamp.

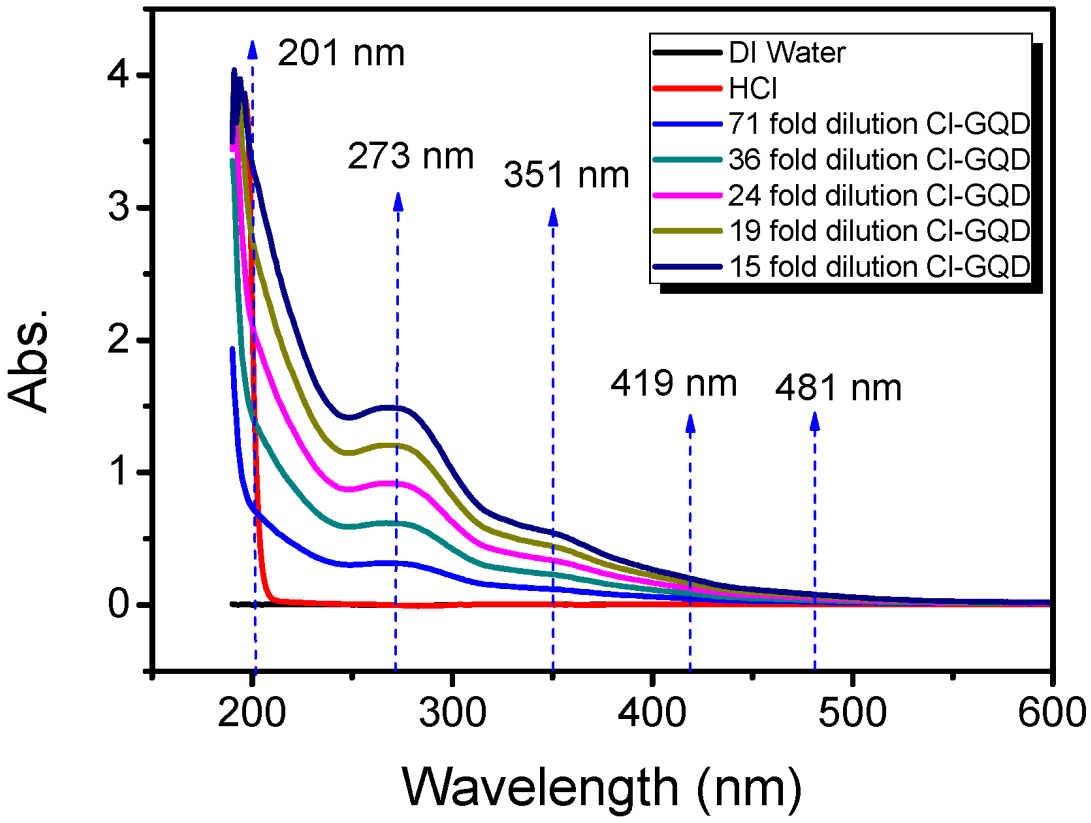

Figure S7. The UV absorption spectra of the Cl-GQDs with different folds of dilution.

3. Supplementary Table

Table S1. The chromaticity coordinates calculated from PL emission spectra excited by various lights

λ_{Ex} [nm]	CIE_X	CIE_Y
300	0.200	0.269
325	0.262	0.305
350	0.319	0.353
375	0.408	0.413
400	0.515	0.435
425	0.521	0.436
450	0.464	0.514
475	0.446	0.530
500	0.585	0.414
525	0.601	0.398
550	0.676	0.324
575	0.674	0.326

Table S2. The fitting parameters of PL decay curves for various emission wavelengths

λ_{Em} [nm]	τ_1 [ns]	τ_2 [ns]	τ_3 [ns]	B_1	B_2	B_3	R_1 [(a)]	R_2 [(a)]	R_3 [(a)]	A	χ^2	$\tau_{average}$ [ns][(b)]
395	0.58	2.65	55.75	92774.19	5050.31	146.65	0.9470	0.0515	0.0015	15.270	3.689	**0.77**
435	0.56	2.39	30.94	174535.27	17313.81	423.55	0.9077	0.0900	0.0022	140.826	2.511	**0.79**
528	0.88	2.60	27.12	455955.25	46222.81	1004.92	0.9061	0.0919	0.0020	318.760	11.393	**1.09**
606	0.61	2.17	107.64	345568.22	27725.85	832.85	0.9237	0.0741	0.0022	-155.587	7.656	**0.96**
714	0.63	2.37	34.93	20278.49	1495.90	39.37	0.9296	0.0686	0.0018	13.165	1.469	**0.81**

(a) The photoluminescence decay curves were fitted to a triple-exponential function: $I(t) = A + B_1 \cdot e^{(-t/\tau_1)} + B_2 \cdot e^{(-t/\tau_2)} + B_3 \cdot e^{(-t/\tau_3)}$, R_i is the relative ratio factor which is calculated by $R_i = B_i / (\sum_{i=1}^{3} B_i)$.

(b) τ_{average} is the average lifetime, τ_{average} is calculated according to $\tau_{average} = \sum_{i=1}^{3} R_i \cdot \tau_i$.