Electronic Supplementary Material (ESI) for Green Chemistry.

Supporting online materials for

Gram-scale synthesis of single-crystalline graphene quantum dots derived from lignin biomass

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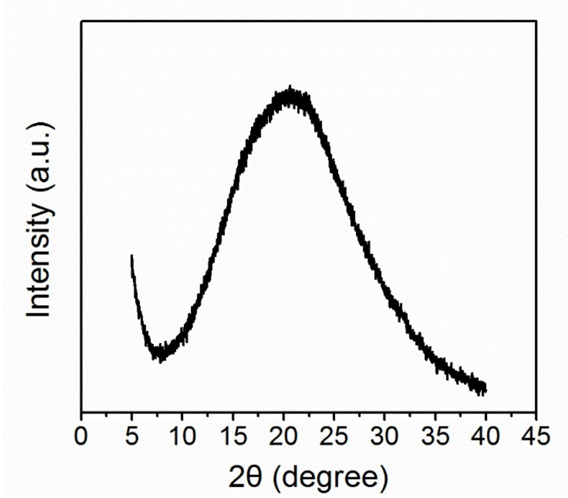

Figure S1. XRD pattern of AL.

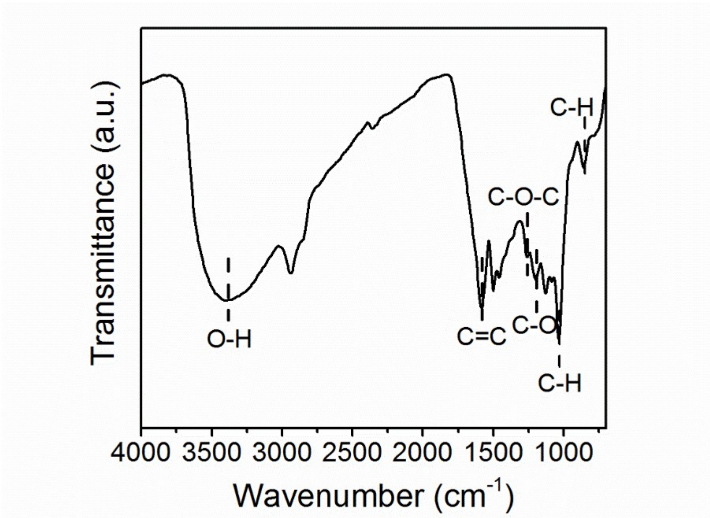

Figure S2. FT-IR analysis of AL.

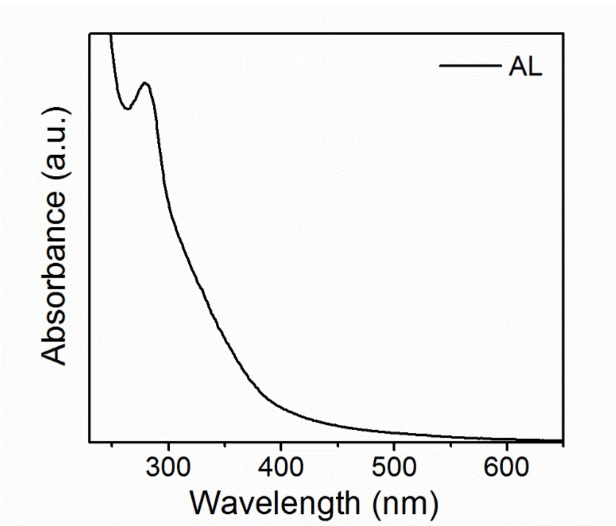

Figure S3. UV-vis spectrum of AL.

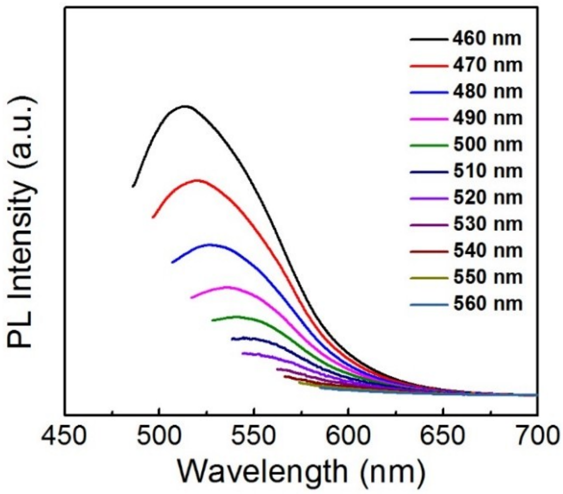

Figure S4. PL emission spectra with excitation wavelength from 460 to 560 nm.

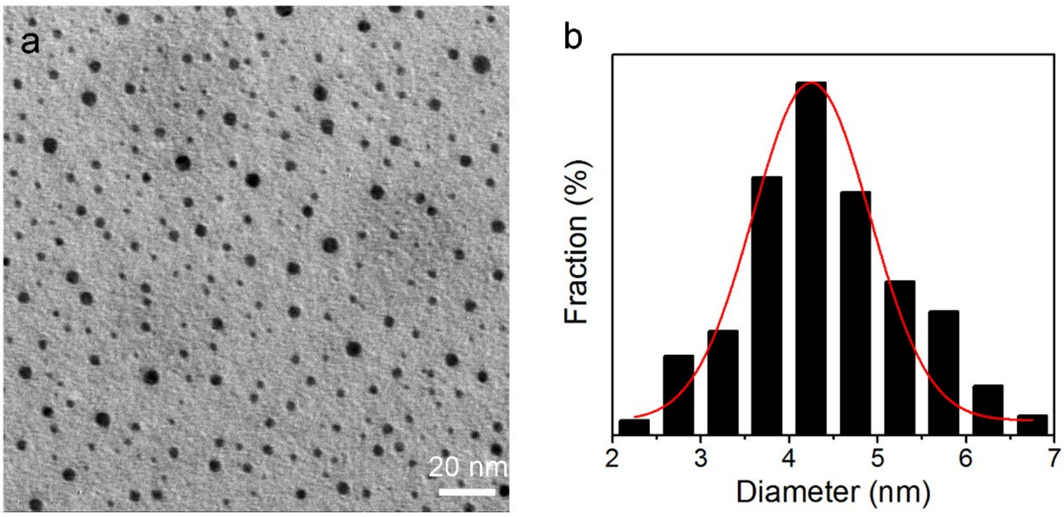

Figure S5. (a) TEM image and (b) size distribution of GQDs with average lateral size of 4.4 nm.

Table 1. Summary of biomass-based carbon quantum dots

Precursor	Synthetic Method	Quantum Yield (%)	Reference
Urine	Carbonization at 200 ^{o}C	5.3	1
Orange juice	Hydrothermal treatment at 120 ^{o}C	26	S1
Food waste	Ultrasound irradiation (40 kHz)	2.85	37
Garlic	Hydrothermal treatment at 200 ^{o}C	17.5	2
Orange peel	Hydrothermal treatment at 180 ^{o}C	36	36
Glucose	Hydrothermal treatment at 200 ^{o}C	1.1-2.4	S2
Grass	Hydrothermal treatment at 150−200 ^{o}C	2.5-6.2	S3
Hemicellulose	Hydrothermal treatment at 200 ^{o}C	16.18	S4
Soybean	Carbonization at 200 ^{o}C	3.17	S5
Carbon soot	HNO_3 oxidation at 100 ^{o}C	3	S6
Rice husk	Ultrasonic treatment	8.1	33
Watermelon peel	Carbonization at 220 ^{o}C	7.1	S7
Peanut shell	Carbonization at 250 ^{o}C	9.91	S8
Waste paper	Hydrothermal treatment at 150−200 ^{o}C	7.4-11.7	S9
Soy milk	Hydrothermal treatment at 180 ^{o}C	2.6	S10
dead neem leaves	H_2SO_4, HNO_3 treatment	2	34
Sago waste	Carbonization at 250−450 ^{o}C	—	35
Coconut water	Microwave irradiation (800 W)	2.8	S11
Coffee	Stirring at 90 ^{o}C	5.5	S12
Calcium alginate	Hydrothermal treatment	—	S13
Lignin	Hydrothermal treatment at 180 ^{o}C	—	S14
Cellulolytic enzyme lignin	Stirring at room temperature	2.47	S15
Alkali lignin	Two-step method	22	Our work

Table 2. Summary of graphene quantum dots

Precursor	Synthetic Method	Quantum Yield (%)	Reference
Carbon fiber	H_2SO_4, HNO_3 treatment, stirring	—	18
Graphene	Electro-beam lithography	—	S16
Fullerene (C_{60})	Ruthenium-catalysed at 1200 K	—	20
Carbon nanotubes	Two-step electrochemical treatment	5.1-6.3	19
Graphite rod	Electrochemical exfoliation	1.8	16
Graphite	Microwave irradiation, sonicating, H_2SO_4, HNO_3	20	17
Graphene	Electrochemical oxidation,	—	S17
GO	Microwave irradiation, reflux	8.5	S18
Carbon black	HNO_3 reflux	1.7-3.5	S19
GO	Hydrothermal treatment at 70−150 ^oC	19-29	22
GO	Hydrothermal treatment at 120 ^oC, H_2O_2	1-10	S20
Graphite	Hydrothermal treatment at 200 ^oC	7-12.7	S21
Alginate	Pyrolysis and laser irradiation	—	24
Pyrene	Hydrothermal treatment at 200 ^oC	23	6
Methane	Chemical Vapor Deposition	—	25
Benzene derivatives	Oxidative condensation reactions	—	29
Citric acid	Hydrothermal treatment at 200 ^oC	2.2	30
Glucose	Microwave-assisted hydrothermal	7-11	26
Polythiophene derivatives	Hydrothermal treatment at 170 ^oC	—	28
Hexabenzocoronene	Pyrolysis at 1200 ^oC and exfoliation	3.8	27
Benzoquinone	Chemical synthesis with TETA	17.5-35.3	5
Dead neem leaves	H_2SO_4, HNO_3 treatment,	2	34
Rice husk	Ultrasonic treatment	8.1	33
Alkali lignin	Two-step method	22	Our work

Supplementary References

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