



Carbon Quantum Dots for Wastewater treatment and Drug Delivery

DR NONNI SORAYA SAMBUDI

SENIOR LECTURER,

CHEMICAL ENGINEERING DEPARTMENT

UNIVERSITI TEKNOLOGI PETRONAS

Carbon quantum dots (CQDs)



HRTEM images of selected Si-CQD samples at 200°C and pH 12.

Wongso, V., Sambudi, N.S., Sufian, S. et al. The effect of hydrothermal conditions on photoluminescence properties of rice huskderived silica-carbon quantum dots for methylene blue degradation. *Biomass Conv. Bioref*. (2020). https://doi.org/10.1007/s13399-020-00662-9





Decolorization of MB (10 ppm) under visible light irradiation

Functionalized CQDs

Metal detection



PL spectra of (a) carboxyl functionalized CQDs and (b) amino functionalized CQDs upon addition of Cadmium ion with increasing concentrations.

Nur Hafizah Zainal Abidin, Viona Wongso, Khee Chung Hui, Kuk Cho, Nonni Soraya Sambudi, Wei Lun Ang, Bahruddin Saad, The effect of functionalization on rice-husks derived carbon quantum dots properties and cadmium removal, *Journal of Water Process Engineering*, Volume 38, 2020, 101634

Functionalized CQDs

Metal removal



Percentage removal of Cd^{2+} with respect to a) volume of functionalized CQDs (initial cadmium concentration 100 ppm), b) initial concentration of cadmium (dosage of CQDs= 3 ml) [contact time=60 mins], c) solution's pH [contact time=60 mins, dosage of CQDs= 3 ml, initial cadmium concentration =100 ppm].

Nur Hafizah Zainal Abidin, Viona Wongso, Khee Chung Hui, Kuk Cho, Nonni Soraya Sambudi, Wei Lun Ang, Bahruddin Saad, The effect of functionalization on rice-husks derived carbon quantum dots properties and cadmium removal, *Journal of Water Process Engineering*, Volume 38, 2020, 101634

Doped-CQDs

MB Degradation (10 ppm)

0.30 -





1.0 -

Khee Chung Hui, Wei Lun Ang, Nonni Soraya Sambudi, Nitrogen and bismuthdoped carbon quantum dots for dye degradation and heavy metal removal, *submitted*.

CQDs/TiO₂

• Photocatalytic degradation

CQDs could improve the quantum yield of TiO₂ which speed up the degradation of pharmaceutical waste and improve its response to visible light.



Photocatalytic performance of 1 %C-T100 composite in removing of various acetaminophen concentration under sunlight irradiation.

Viona Wongso, Hui Khee Chung, Nonni Soraya Sambudi, Suriati Sufian, Bawadi Abdullah, Muhammad Dzul Hakim Wirzal, Wei Lun Ang, Silica–carbon quantum dots decorated titanium dioxide as sunlight-driven photocatalyst to diminish acetaminophen from aquatic environment, *Journal of Photochemistry and Photobiology A: Chemistry*, Volume 394, 2020, 112436



Muhammad Wahyu Nugraha, Nur Hafizah Zainal Abidin, Supandi, Nonni Soraya Sambudi, Synthesis of Tungsten Oxide/ Amino-functionalized Sugarcane Bagasse Derived-Carbon Quantum Dots (WO3/N-CQDs) Composites for Methylene Blue Removal, *under review*.

HRTEM images of WO₃/N-CQDs 2.5%

CQDs/Hydroxyapatite

• Drug delivery



FESEM images of a HAP and b CD-HAP

Sample	Surface area (m ² /g)	Pore volume (cm ³ /g)	Pore diameter (nm)
HAP	41.631	0.334	30.959
CD-HAP (20 ml CD)	54.095	0.351	22.756
CD-HAP (40 ml CD)	78.752	0.435	22.357

Chung, H.K., Wongso, V., Sambudi, N.S. *et al.* Biowaste-derived carbon dots/hydroxyapatite nanocomposite as drug delivery vehicle for acetaminophen. *J Sol-Gel Sci Technol* **93**, 214–223 (2020)



a) Drug release profiles of samples; b Higuchi kinetic model fitting of samples

Functionalized CQDs in Thin Film Membrane

Nanofiltration





Contact angle of (a)PSf, (b)TFC, (c) TFN with CQDs, (d) TFN with CCQDs, and (e) TFN with NCQDs

FESEM characterizations of top and cross-sectional surfaces for (d-i) TFN with CCQDs, and (e-j) TFN with NCQDs

Nur Hafizah Zainal Abidin, Hazwani Suhaimi, Nonni Soraya Sambudi, Nik Abdul Hadi Nik Sapiaa, Incorporation of functionalized carbon quantum dots in thin film membrane for nanofiltration, under review.

Functionalized CQDs in Thin Film Membrane

Nanofiltration



Nur Hafizah Zainal Abidin, Hazwani Suhaimi, Nonni Soraya Sambudi, Nik Abdul Hadi Nik Sapiaa, Incorporation of functionalized carbon quantum dots in thin film membrane for nanofiltration, *under review*.

CUReS (Centre of Urban Resource Sustainability) - Wastewater treatment







CAL (Central Analytical Laboratory)

- Transmission Electron Microscope (TEM)
- Field-Emission Scanning Electron Microscope (FESEM)
- Universal Scanning Probe Microscope (USPM)
- X-ray Photoelectron Spectrometer (XPS)
- Fourier Transform Infrared Spectrometer (FTIR)
- Raman Spectrometer
- Atomic Absorption Spectrometer (AAS)
- Surface Area Analyser and Porosimetry System
- Liquid Chromatograph-Mass Spectrometer (LC/MS)
- X-ray Diffractometer (XRD)

Atomic Absorption Spectrometer (AAS) Model: Agilent 240FS



Surface Area Analyzer and Porosimetry System Model: Micromeritics ASAP 2020



Universal Scanning Probe Microscope (USPM) Model: Nano Navi (E-Sweep)



X-ray Photoelectron Spectrometer (XPS) Model: Thermo Scientific K-Alpha

