



Carbon Quantum Dots for Wastewater treatment and Drug Delivery

DR NONNI SORAYA SAMBUDI

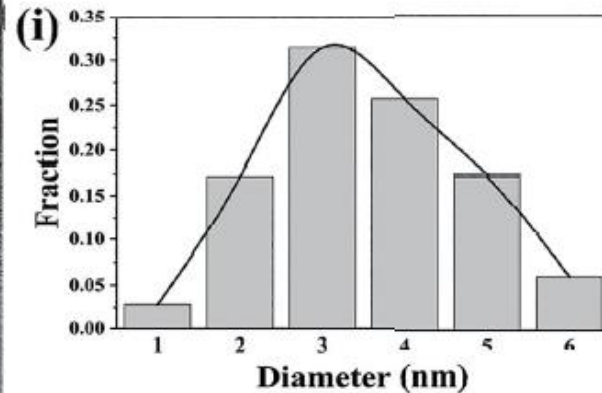
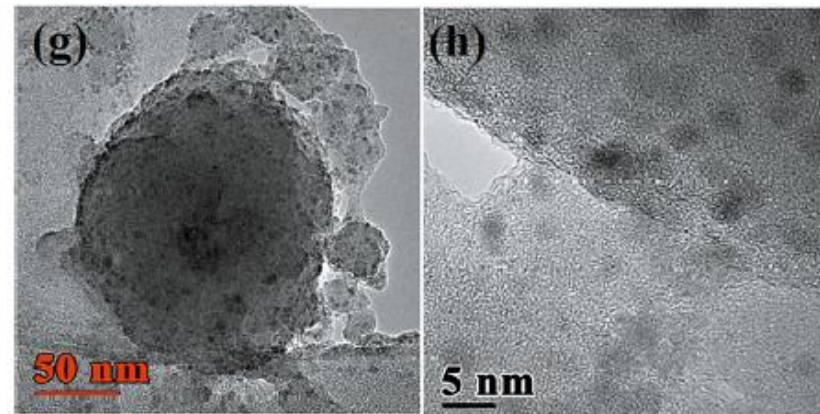
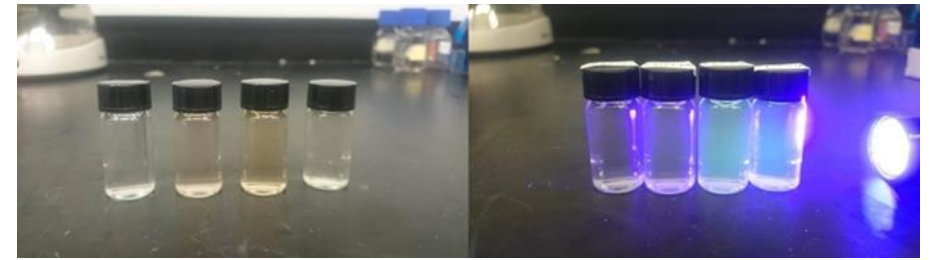
SENIOR LECTURER,

CHEMICAL ENGINEERING DEPARTMENT

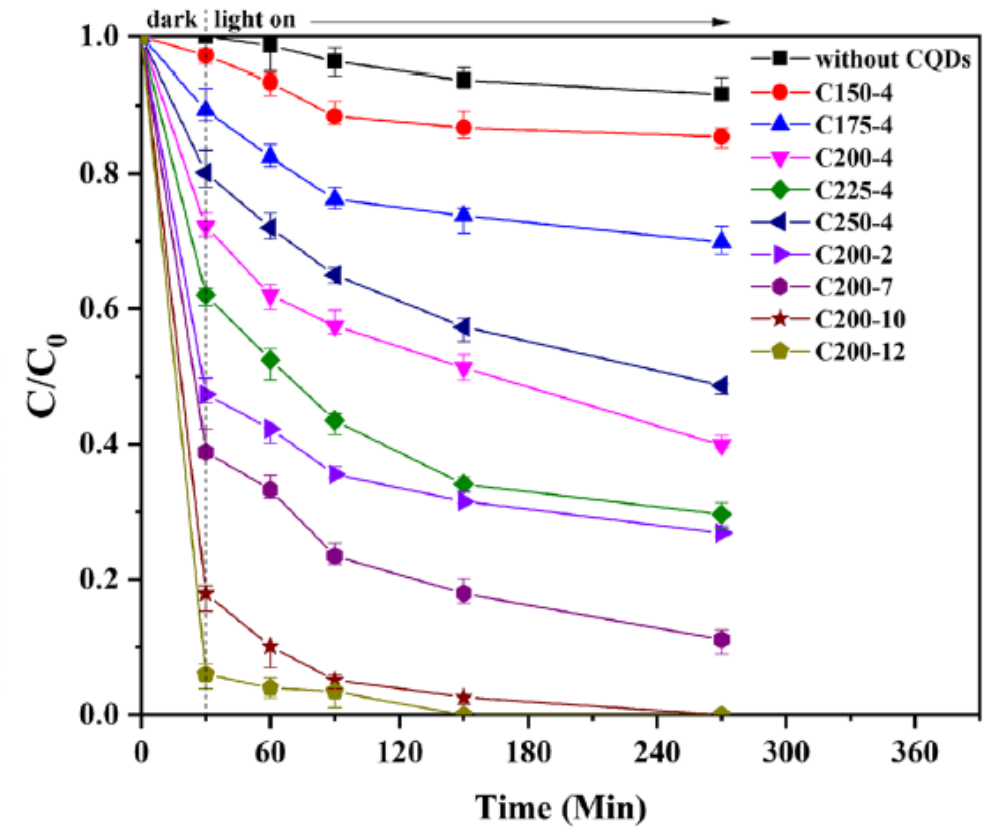
UNIVERSITI TEKNOLOGI PETRONAS



Carbon quantum dots (CQDs)



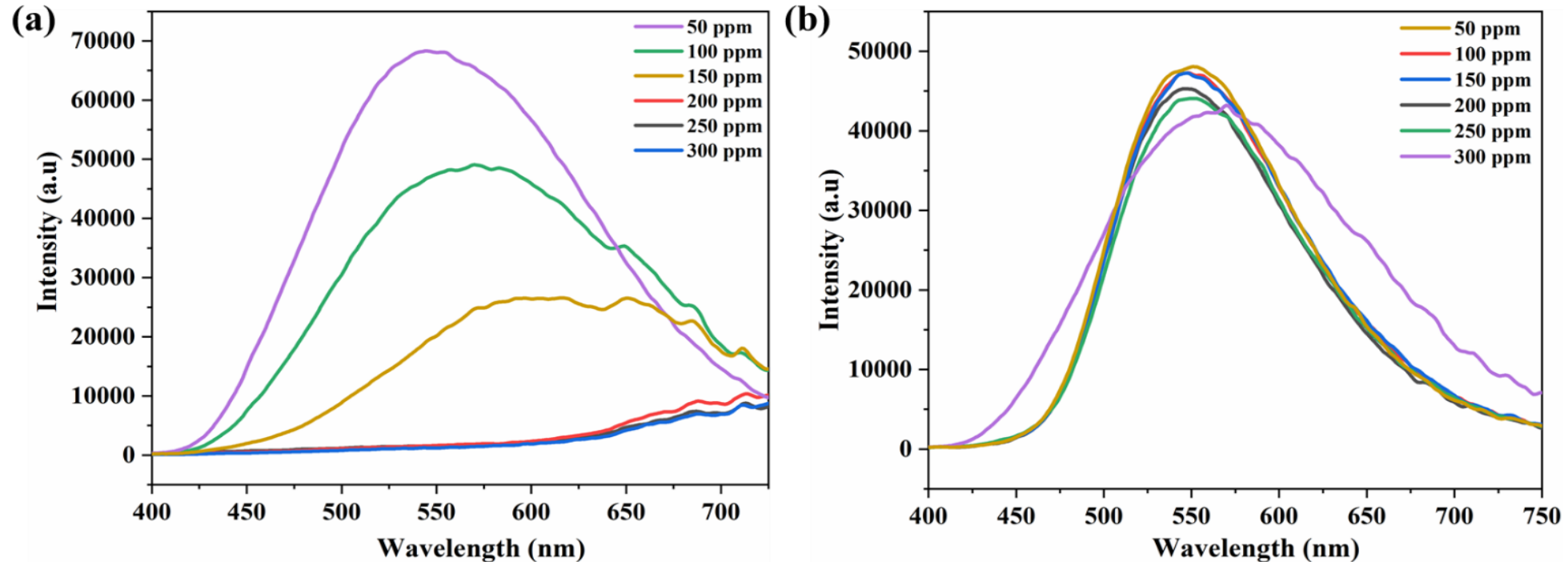
HRTEM images of selected Si-CQD samples at 200°C and pH 12.



Decolorization of MB (10 ppm) under visible light irradiation

Functionalized CQDs

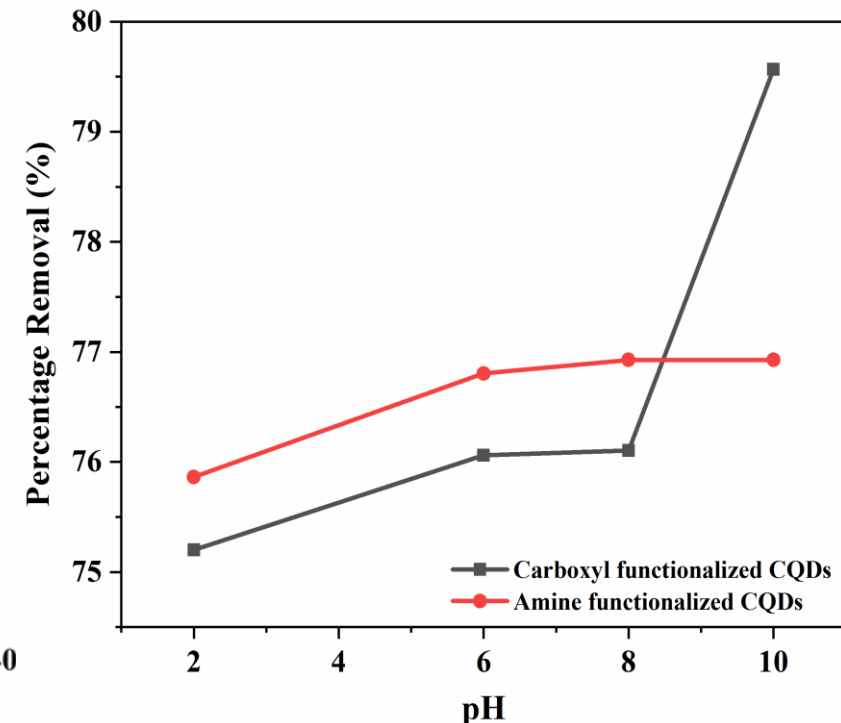
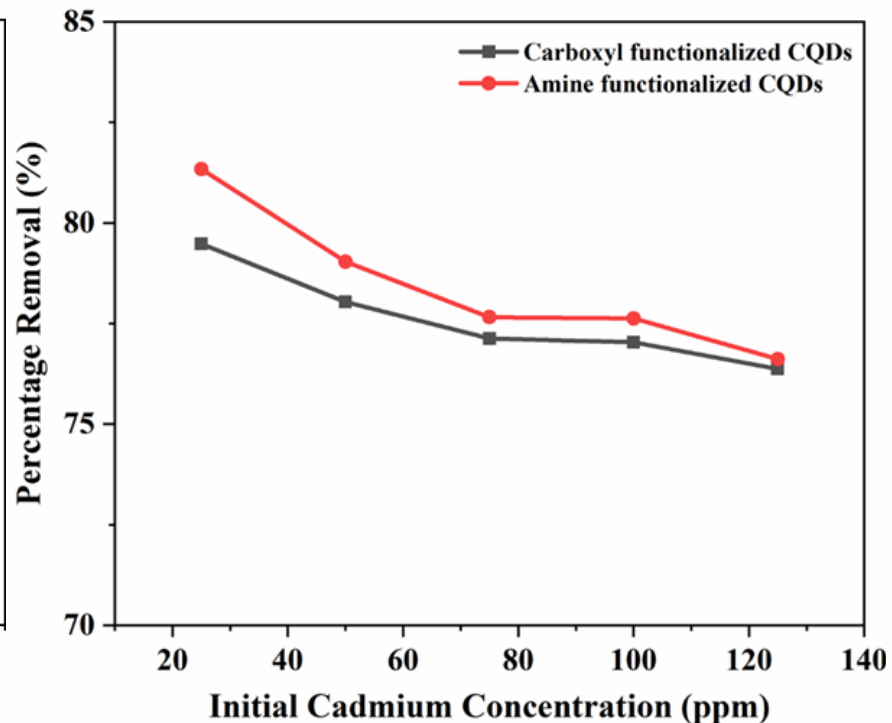
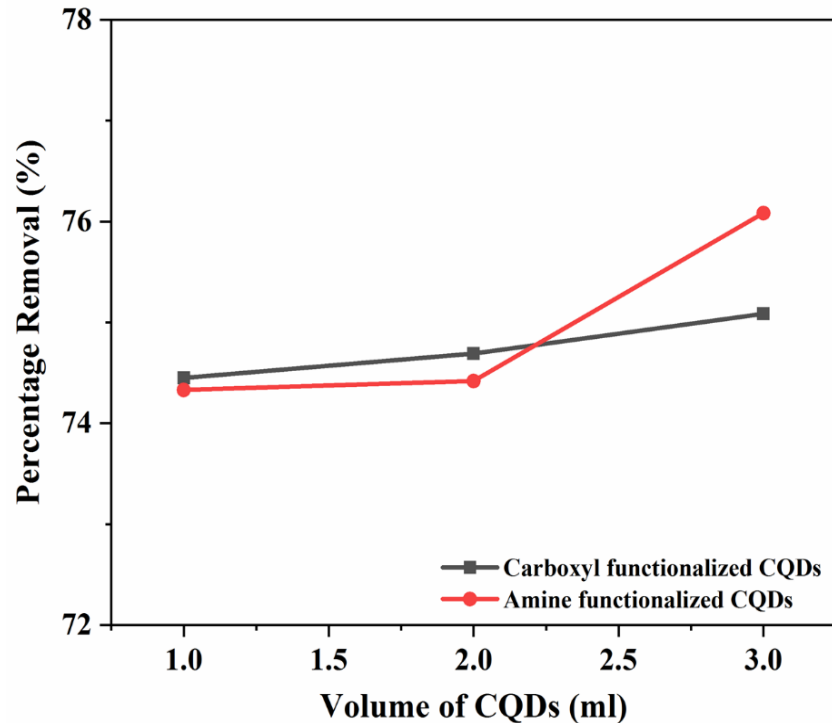
- Metal detection



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

Functionalized CQDs

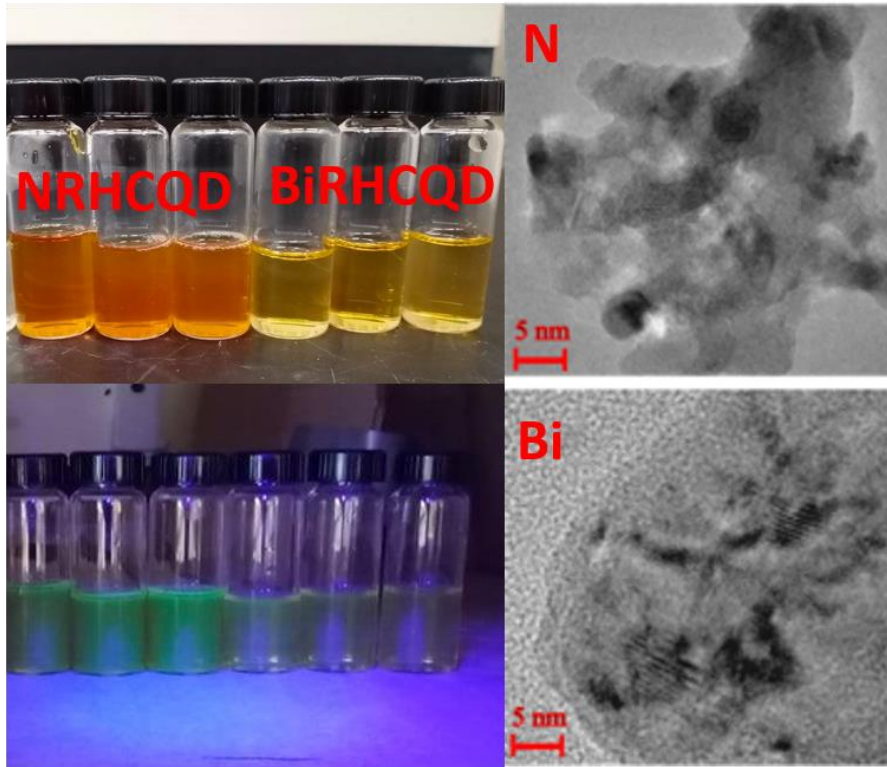
- Metal removal



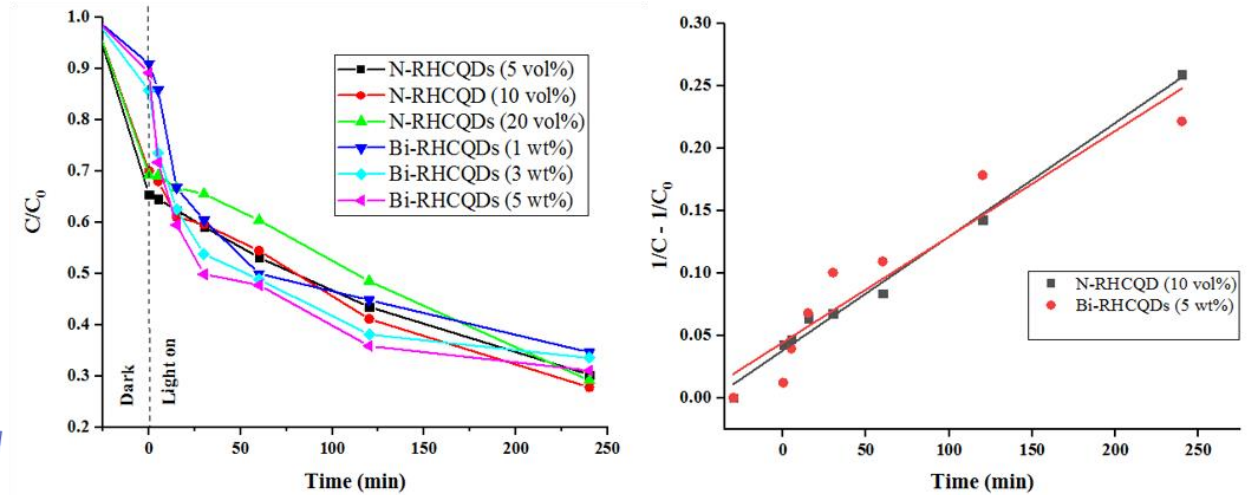
Percentage removal of Cd²⁺ with respect to a) volume of functionalized CQDs (initial cadmium concentration 100 ppm), b) initial concentration of cadmium (dosage of CQDs= 3 ml) [contact time=60 mins], c) solution's pH [contact time=60 mins, dosage of CQDs= 3 ml, initial cadmium concentration =100 ppm].

Doped-CQDs

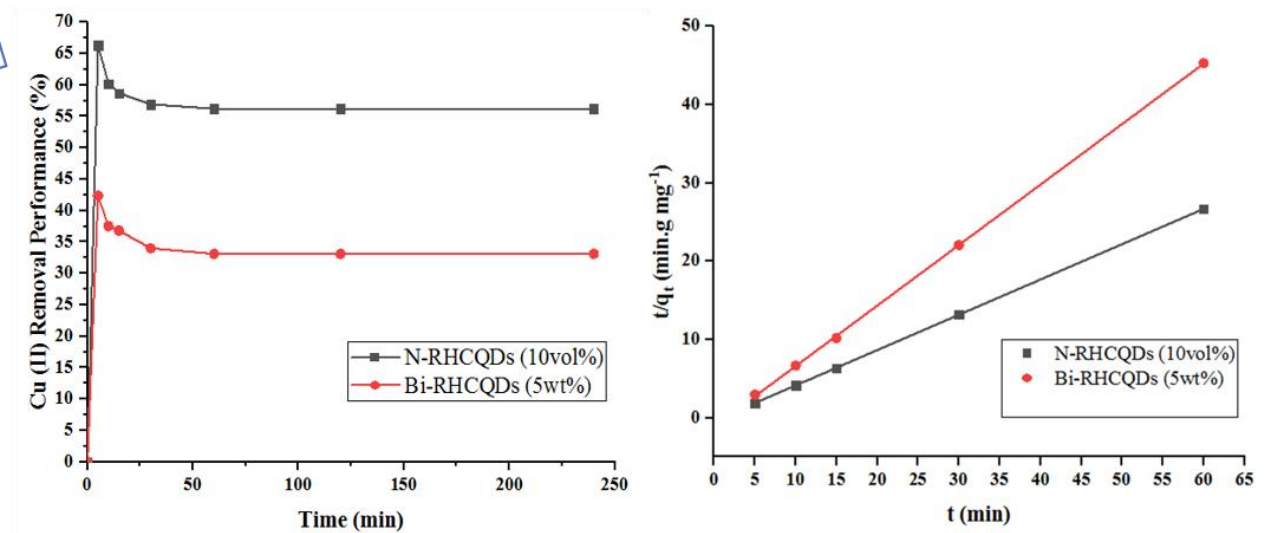
N-RHCQDs and Bi-RHCQDs



MB Degradation (10 ppm)



Cu (II) Removal (10 ppm)

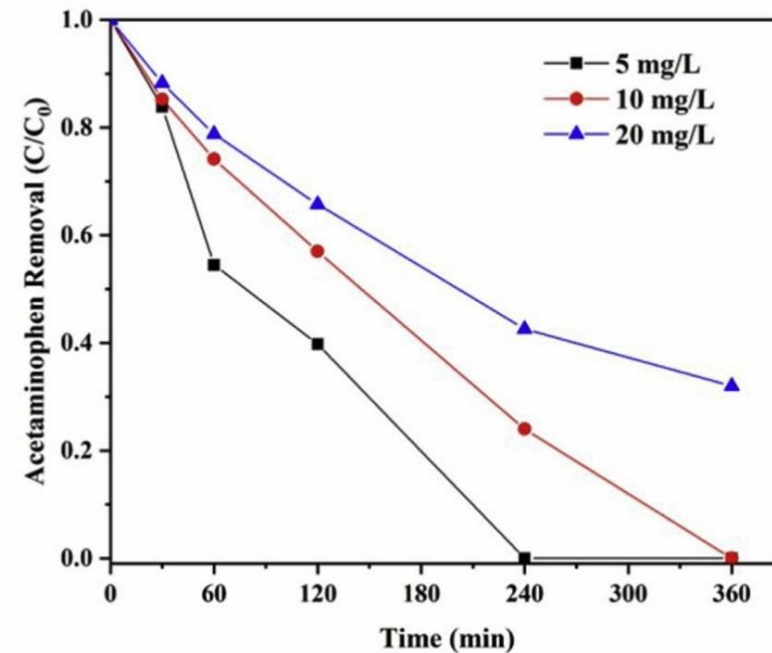
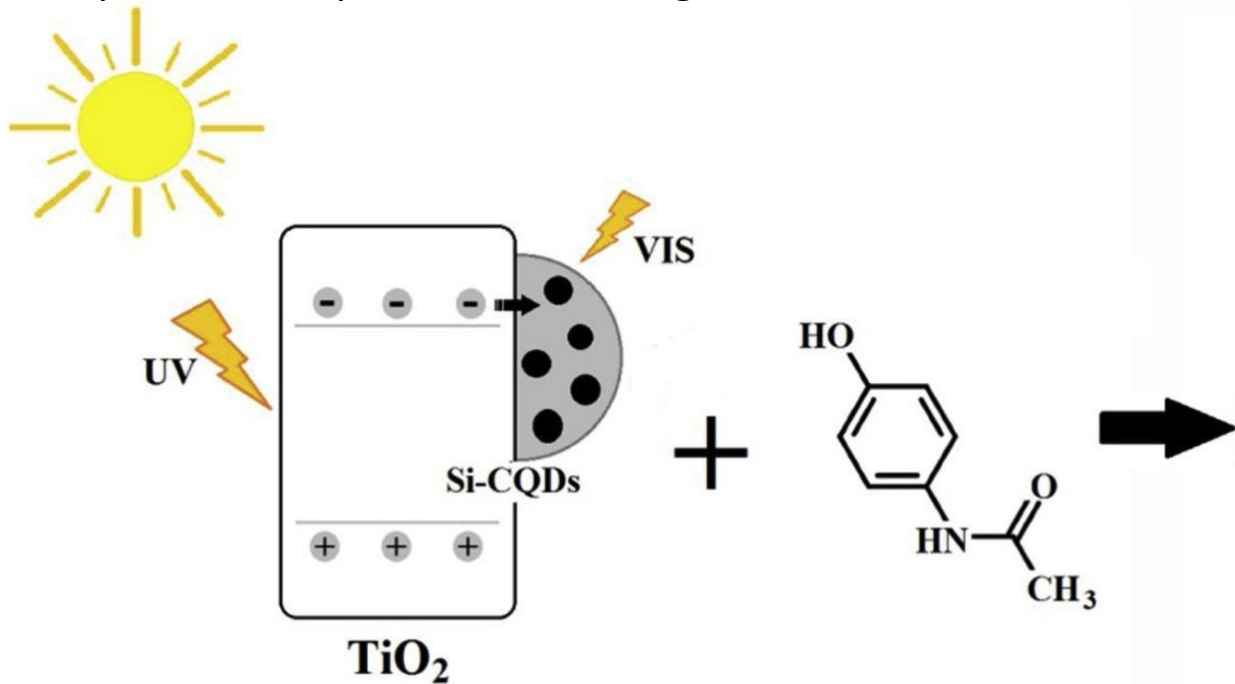


Khee Chung Hui, Wei Lun Ang, Nonni Soraya Sambudi, Nitrogen and bismuth-doped carbon quantum dots for dye degradation and heavy metal removal, *submitted*.

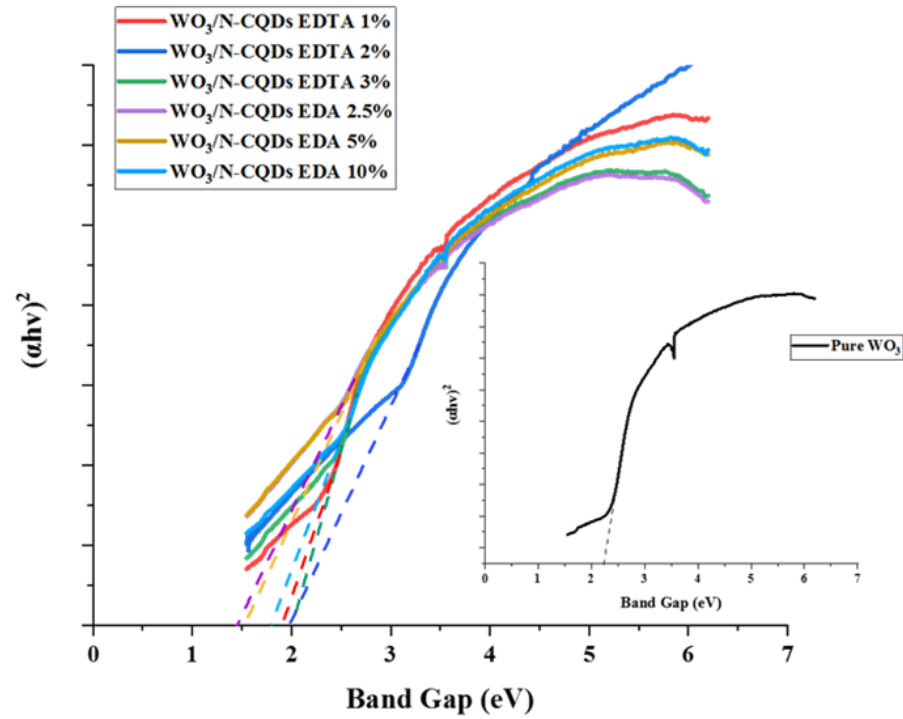
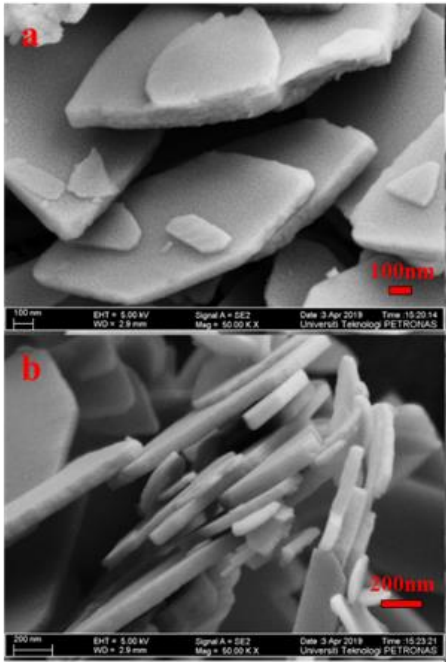
CQDs/TiO₂

- Photocatalytic degradation

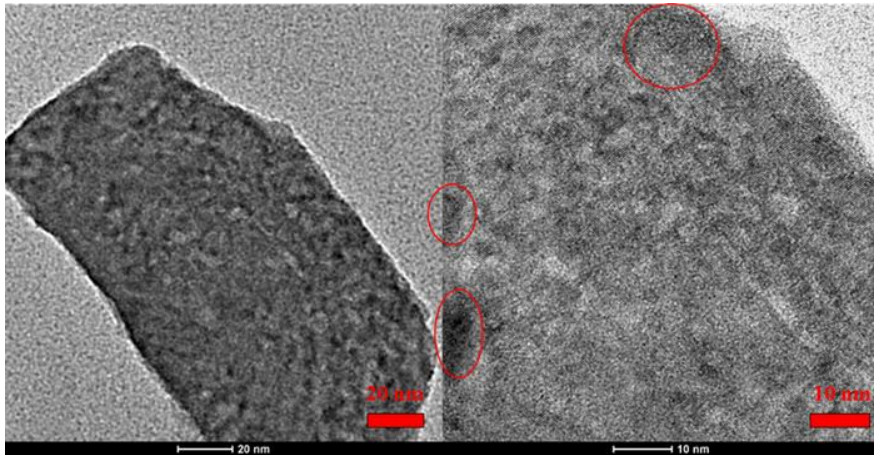
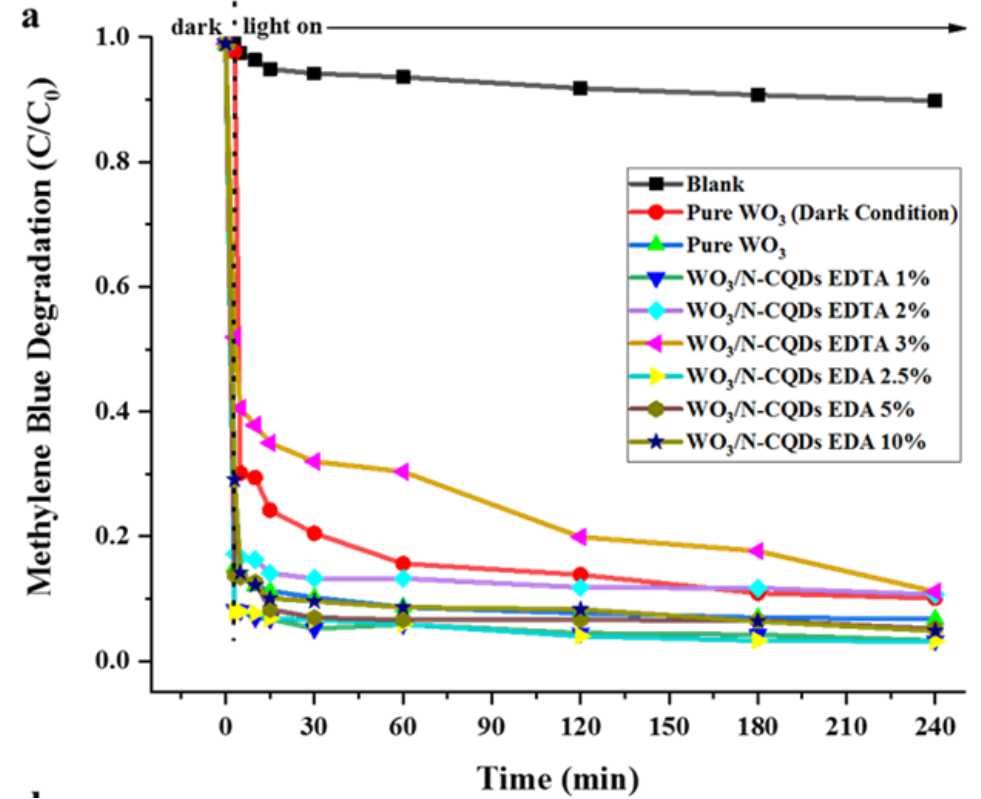
CQDs could improve the quantum yield of TiO₂ which speed up the degradation of pharmaceutical waste and improve its response to visible light.



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



CQDs/WO₃

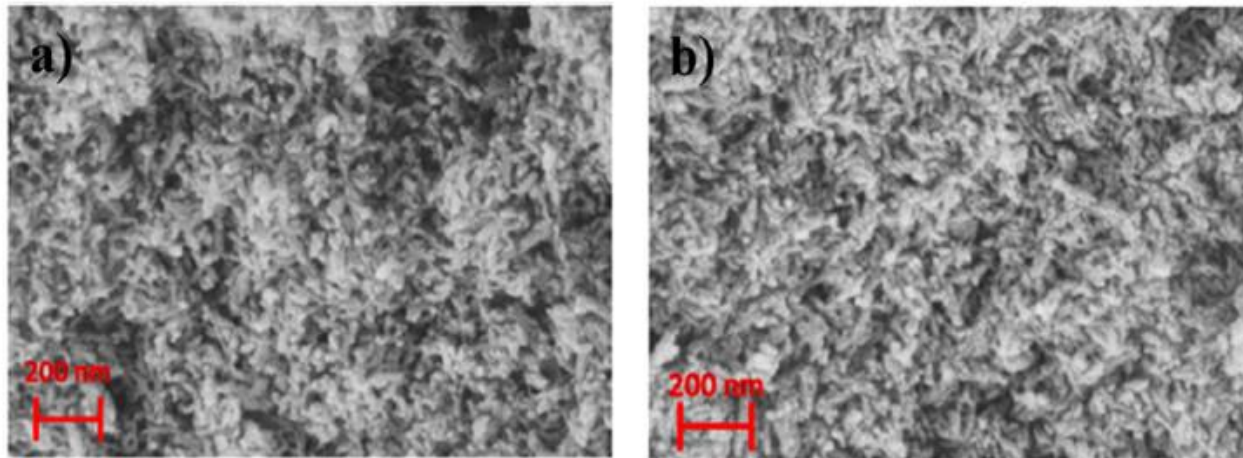


HRTEM images of WO₃/N-CQDs 2.5%

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*.

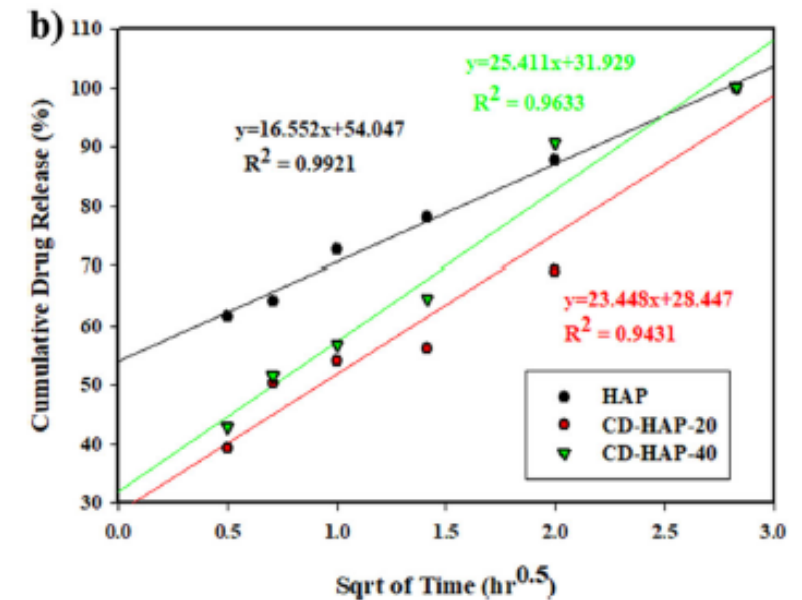
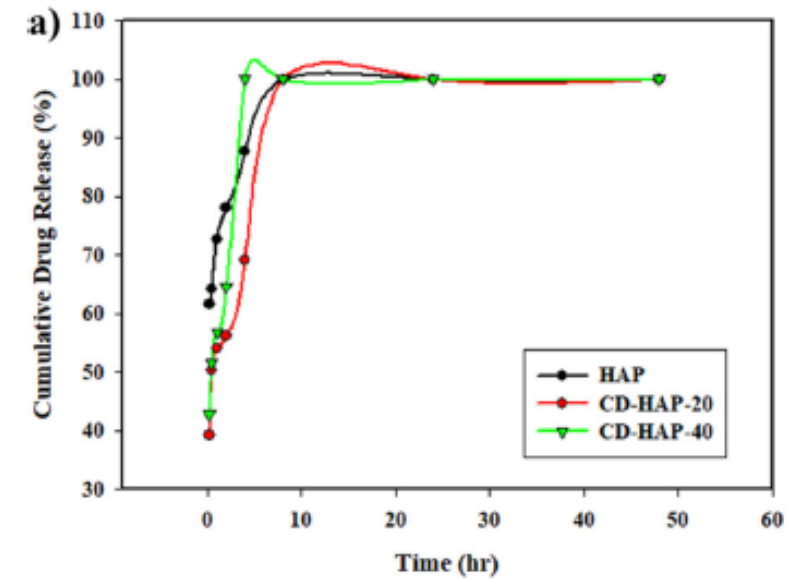
CQDs/Hydroxyapatite

- Drug delivery



FESEM images of a HAP and b CD-HAP

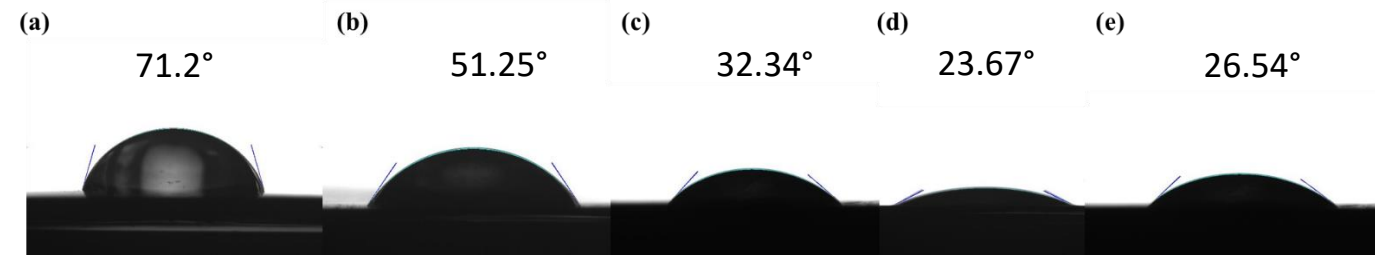
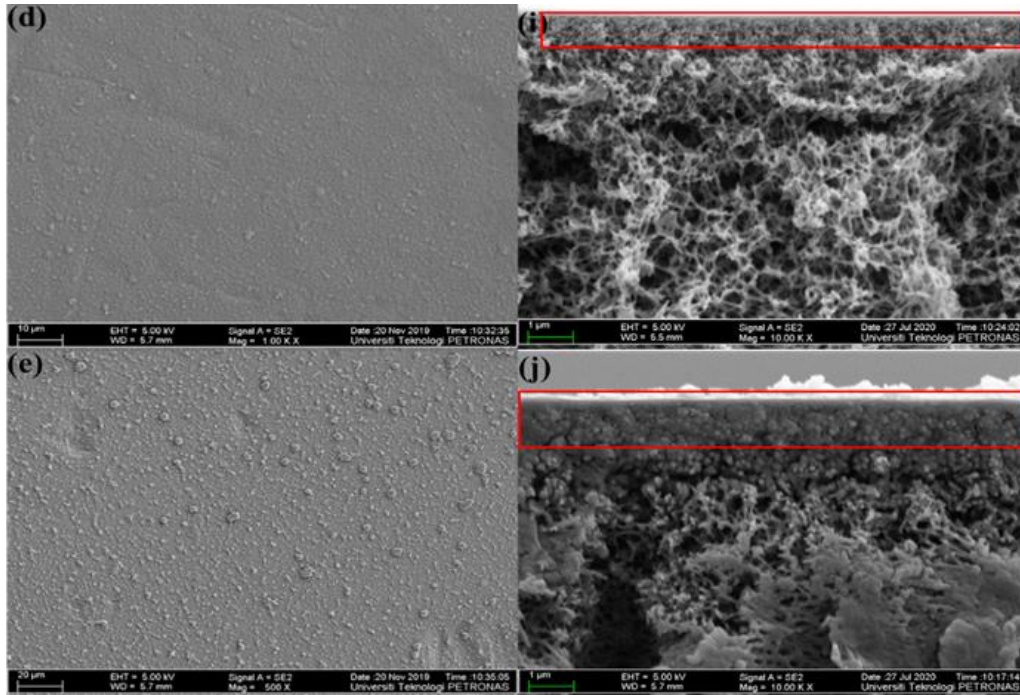
Sample	Surface area (m ² /g)	Pore volume (cm ³ /g)	Pore diameter (nm)
HAP	41.631	0.334	30.959
CD-HAP (20 ml CD)	54.095	0.351	22.756
CD-HAP (40 ml CD)	78.752	0.435	22.357



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

Functionalized CQDs in Thin Film Membrane

- Nanofiltration

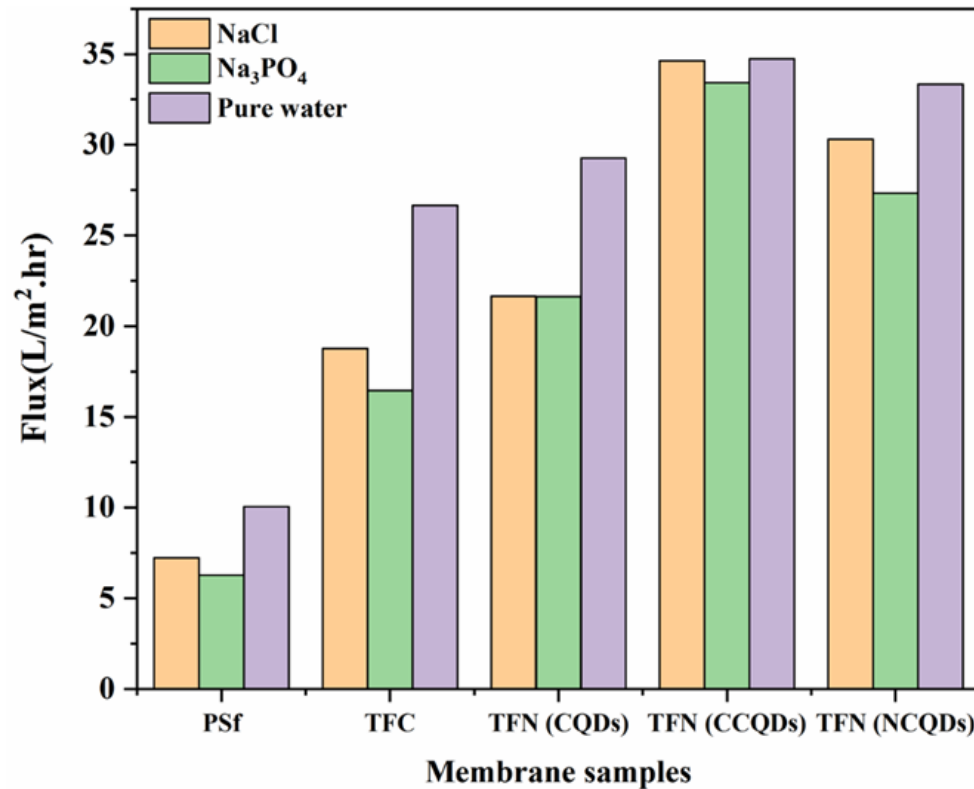


Contact angle of (a)PSf, (b)TFC, (c) TFN with CQDs, (d) TFN with CCQDs, and (e) TFN with NCQDs

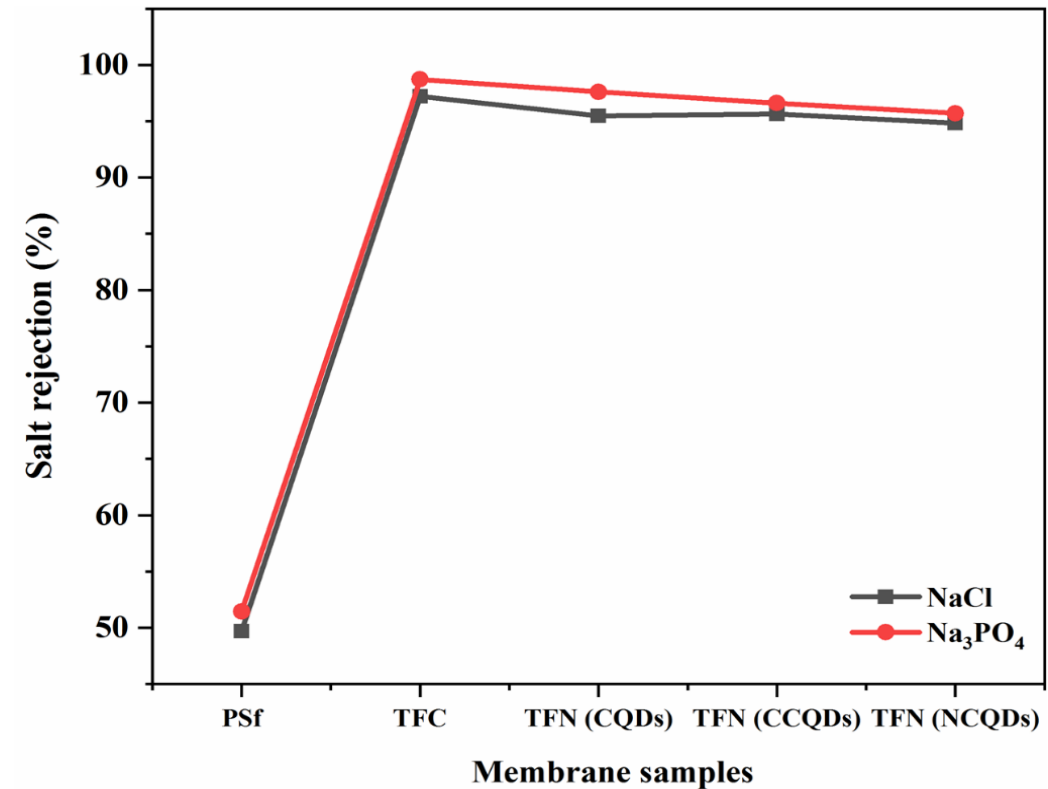
FESEM characterizations of top and cross-sectional surfaces for (d-i) TFN with CCQDs, and (e-j) TFN with NCQDs

Functionalized CQDs in Thin Film Membrane

- Nanofiltration



Permeate flux of membrane samples



Salt rejection of membrane samples

CUReS (Centre of Urban Resource Sustainability)

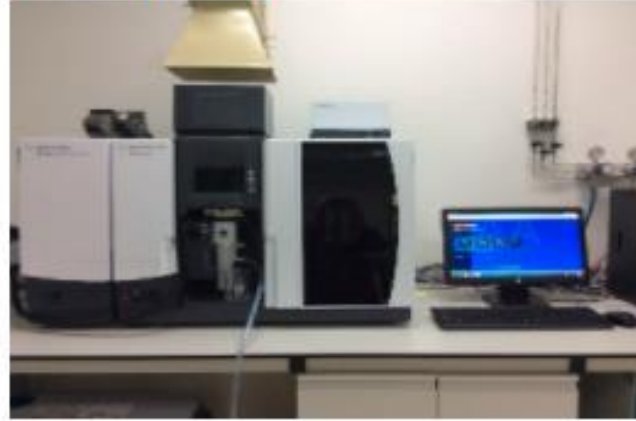
- Wastewater treatment



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)

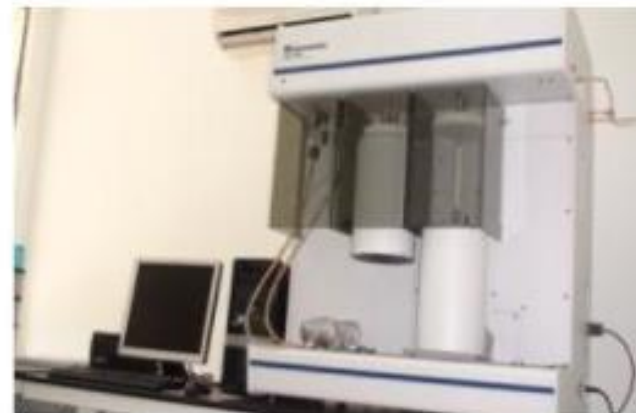
Atomic Absorption Spectrometer (AAS)
Model: Agilent 240FS



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



Surface Area Analyzer and Porosimetry System
Model: Micromeritics ASAP 2020



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

