Carbon Quantum Dots for Wastewater treatment and Drug Delivery

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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

https://doi.org/10.1007/s13399-020-00662-9
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

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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].

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Doped-CQDs

N-RHCQDs and Bi-RHCQDs

CQDs/TiO$_2$

- Photocatalytic degradation

CQDs could improve the quantum yield of TiO$_2$ 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/Hydroxyapatite

• Drug delivery

FESEM images of a HAP and b CD-HAP

<table>
<thead>
<tr>
<th>Sample</th>
<th>Surface area (m²/g)</th>
<th>Pore volume (cm³/g)</th>
<th>Pore diameter (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAP</td>
<td>41.631</td>
<td>0.334</td>
<td>30.959</td>
</tr>
<tr>
<td>CD-HAP (20 ml CD)</td>
<td>54.095</td>
<td>0.351</td>
<td>22.756</td>
</tr>
<tr>
<td>CD-HAP (40 ml CD)</td>
<td>78.752</td>
<td>0.435</td>
<td>22.357</td>
</tr>
</tbody>
</table>

Functionalized CQDs in Thin Film Membrane

• Nanofiltration

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

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