Electronic Supplementary Information

CuO nanoleaves and β-cyclodextrin functionalized reduced graphene oxide: A highly selective and sensitive electrochemical sensor for the simultaneous detection of 2-chlorophenol and 2, 4-dichlorophenol

Umme Solaem Akonda, Abhinandan Mahanta and Sk. Jasimuddina

Department of Chemistry, Assam University, Silchar, Assam-788011, India

Fig. S1 FTIR spectra of CuO nanoleaves

Fig. S2 UV-visible spectra of CuO nanoleaves in aqueous solution
Fig. S3 X-ray diffraction pattern of CuO NLs.

Fig. S4a ATR-FTIR of rGO-GCE

Fig. S4b ATR-FTIR of β-CD-rGO-GCE

Fig. S4c ATR-FTIR of CuO-β-CD-rGO-GCE
**Fig. S5** Overlaid Nyquist plots (Z’ versus Z’, E<sub>ac</sub> = 10 mV, frequency range: 0.01-100000 Hz) of 0.5 mM K₃[Fe(CN)₆] in 0.1 M PBS (pH 7.0) at GCE (green curve), rGO-GCE (brown curve), β-CD-rGO-GCE (red curve) and CuO NLs-β-CD-rGO-GCE (blue curve). Data points are experimental while the solid lines are the fitted lines (Inset: Randles equivalent circuit used to fit the EIS data).

**Fig. S6** Cyclic voltammograms obtained at bare and CuO NLs-β-CD-rGO modified GCE in 0.1 m PBS (pH 7.0).
Fig. S7 Overlaid cyclic voltammograms obtained with increasing scan rate at CuO NLS-\(\beta\)-CD-rGO-GCE in 0.1 m PBS (pH 7.0) (a); A plot of current density (J) versus scan rate (v) (b).

Fig. S8 Overlaid CVs for 0.1 M PBS (red curve) and 10 \(\mu\)M 2-CP in 0.1 M PBS (pH 6.0) (blue curve) (a); Overlaid CVs for 0.1 M PBS (red curve) and 10 \(\mu\)M 2,4-DCP in 0.1 M PBS (pH 6.0) (green curve) (b).

Fig. S9 A plot of current as a function of concentration of 2-CP with linear trend line \(R^2 > 0.99\) (a); A plot of current as a function of concentration of 2,4-DCP with linear trend line \(R^2 > 0.99\) (b).

Fig. S10 CVs of 10 \(\mu\)M 2-CP (a) and 10 \(\mu\)M 2,4-DCP (b) in 0.1 M PBS (pH 6.0) at different scan rate (20-100 mVs\(^{-1}\)) using CuO NLS-\(\beta\)-CD-rGO-GCE.
**Fig. S11** Plot of oxidation peak current of 10 μM 2-CP (a) and 10 μM 2,4-DCP (b) versus scan rate.

**Fig. S12** A plot of scan rate–normalized current versus scan rate.

**Fig. S13** Plot of oxidation peak current of 10 μM 2-CP (a) and 10 μM 2,4-DCP (b) versus square root of scan rate.
Fig. S14 Plot of $E_{pa}$ versus $\ln \gamma$ for 2-CP (a) and 2,4-DCP (b)

Fig. S15 Overlaid CVs of 10 $\mu$M 2-CP at different pH using CuO NLs-β-CD-rGO-GCE.

Fig. S16 Overlaid CVs of 10 $\mu$M 2,4-DCP at different pH using CuO NLs-β-CD-rGO-GCE.
Fig. S17 Plot of oxidation peak current of 10 μM 2-CP (a) and 2,4-DCP (b) versus pH at CuO NLs-β-CD-rGO-GCE in 0.1 M PBS.

(a) ![Graph](image1.png)  
(b) ![Graph](image2.png)

Fig. S18 Plot of oxidation peak potential of 10 μM 2-CP versus pH (a); Plot of oxidation peak potential of 10 μM 2,4-DCP versus pH (b).

(a) ![Graph](image3.png)  
(b) ![Graph](image4.png)

Fig. S19 Amperometric response at CuO NLs-β-CD-rGO-GCE with an applied potential of 0.68 V on subsequent addition of 10 μM 2-CP, 50 μM phenol, 50 μM p-aminophenol, 50 μM p-nitrophenol, 50 μM KCl, 50 μM NaCl and 10 μM 2-CP under stirring condition in 0.1 M PBS (pH 6.0).
Fig. S20 Amperometric response at CuO NLS-β-CD-rGO-GCE with an applied potential of 1.0 V on subsequent addition of 10 μM 2,4-DCP, 50 μM phenol, 50 μM p-aminophenol, 50 μM p-nitrophenol, 50 μM KCl, 50 μM NaCl and 10 μM 2,4-DCP under stirring condition in 0.1 M PBS (pH 6.0).

Fig. S21 Chronoamperogram obtained by using CuO NLS-β-CD-rGO-GCE at an applied potential 0.68 V and 1.0 V in the presence of 10 μM 2-CP (a) and 10 μM 2,4-DCP (b), respectively in 0.1 m PBS (pH 6.0).

Fig. S22 Overlaid DPVs of a mixed solution of 5 μM 2-CP and 5 μM 2,4-DCP in 0.1 M PBS (pH 6.0) obtained by using the CuO NLS-β-CD-rGO-GCE (DPVs were taken fifteen days interval and the electrode was kept by covering a Teflon cap when not in use).
Table S1 Simultaneously analysis of 2-CP and 2,4-DCP in spiked water sample

<table>
<thead>
<tr>
<th>River water a</th>
<th>Spiked (μM)</th>
<th>Found(μM)</th>
<th>RSD (%) (n = 5)</th>
<th>Recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-CP</td>
<td>0</td>
<td>Not detected</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>1.48</td>
<td>1.01</td>
<td>98.67</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2.03</td>
<td>1.03</td>
<td>101.50</td>
</tr>
<tr>
<td>2,4-DCP</td>
<td>0</td>
<td>Not detected</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>1.43</td>
<td>0.99</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1.96</td>
<td>1.10</td>
<td>98</td>
</tr>
</tbody>
</table>

a Obtained from The Brahmaputra River