Supporting Information

Harvest of Cu NPs anchored magnetic carbon materials from Fe/Cu preloaded biomass: Pyrolysis, characterization, and catalytic activity on aqueous reduction of 4-nitrophenol

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The following is included as supporting information for this manuscript:

Table S1;

Figs. S1-S5.
The crystalline size of Cu NPs from the (111) diffraction peak was calculated by using the Scherrer equation:

\[ d = \frac{k\lambda}{B\cos\theta} \]

where \( d \) (nm) is the crystalline size of Cu NPs, \( K \) is a dimensionless constant depending on the specific geometry of the scattering objects (\( K = 0.94 \) for Cu NPs), \( \lambda \) is the wavelength of the X-ray (\( \lambda = 0.154056 \) nm), \( \theta \) (rad) and \( B \) (rad) are the angles between the incident and diffracted beams and the full width at half-maximum, respectively. Based on the equation, the crystalline size of Cu NPs is 27.3 nm, larger than the average particle size calculated from the TEM images (21.2 nm).
<table>
<thead>
<tr>
<th>Items</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>BET Surface Area</td>
<td>185.7 m²/g</td>
</tr>
<tr>
<td>Micropore Area</td>
<td>137.0 m²/g</td>
</tr>
<tr>
<td>External Surface Area</td>
<td>48.6 m²/g</td>
</tr>
<tr>
<td>Total pore volume</td>
<td>0.097 cm³/g</td>
</tr>
<tr>
<td>micropore volume</td>
<td>0.063 cm³/g</td>
</tr>
<tr>
<td>average pore size</td>
<td>2.1 nm</td>
</tr>
</tbody>
</table>

**Table S1.** The surface area and pore texture of the as-synthesized material.
Fig. S1. Pore size distribution of the as-synthesized materials.
Fig. S2 EDX spectra of the Cu&Fe$_3$O$_4$-mC materials, the A and B is corresponding to the SEM image of Fig. 3a in the main text.
Fig. S3. The TEM images of the fresh, 1<sup>st</sup>, 3<sup>rd</sup>, and 5<sup>th</sup> time reused catalyst materials and their corresponding particle size distribution.
**Fig. S4.** XPS survey spectra of the Cu&Fe3O4-mC materials (after pyrolysis) and its precursor (before pyrolysis).
Fig. S5. (a) XPS survey spectra of the fresh and 5th reused catalyst; and (b) XPS Cu2p spectra of the fresh and 5th reused catalyst.