Efficient Au⁰/C catalyst synthesized by a new method for acetylene hydrochlorination reaction

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1. Experimental

1.1 Materials and reagents

HAuCl₄·4H₂O (assay 49%) and C₂H₅OH were purchased from Guoyao Chemical Reagent Company (Shanghai, China); Activated carbon (20~40 mesh, referred as C1 in following paragraphs) obtained from Guoyao Chemical Reagent Company was used as supports. The surface property and morphology of the carbon are shown in Table S1, Fig. S1); Highly purified Hydrogen Chloride (99.998%) was provided by Shanghai Weichuang Standard Gas Analytical Technology Co., Ltd.; Acetylene (99.5%) was purchased from Jiaxing Tianli Gas Co., Ltd.

1.2 Catalyst characterization

Morphology of activated carbon was obtained by scanning electron microscopy (SEM) using a Hitachi TM-1000 scanning electron microscope. The samples were deposited on carbon holders and evacuated at high vacuum before micrographs were taken.

The texture properties of the carbon was derived from N₂ adsorption – desorption measurements carried out at liquid nitrogen temperature using an ASAP2020 instrument. Prior to any adsorption measurements, each sample was outgassed at...
200°C for 6 h to eliminate air and vapor from the capillaries of the pore structures of the solids. Specific surface areas and pore volume of the samples were calculated applying BET and T-plot models respectively.

2. Results

![Morphology of activated carbon C1.](image)

Fig. S1 Morphology of activated carbon C1.

Table S1 Textural Properties of C1.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Surface area (m²/g)</th>
<th>Pore volume (cm³/g)</th>
<th>Pore Size (nm)</th>
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<tbody>
<tr>
<td>C1</td>
<td>715</td>
<td>0.43</td>
<td>2.45</td>
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Fig. S 2 XPS profiles of fresh MIV-1Au/C1, H₂O-MIV-1Au/C1 and MIV-25-1Au/C1 catalysts.

Fig. S 3 Typical TEM images of (a) H₂O-MIV-1Au/C1 and (b) MIV-25-1Au/C1
Fig. S4 XPS spectrum of MIV-1Au/C1 after 10 min HCl purging before the reaction of acetylene hydrochlorination. The purging process aimed to get rid of the adsorbed N\textsubscript{2} in catalysts during the heating process.

Fig. S5 XPS spectrum of MIV-1Au/C1 after 15 min of acetylene hydrochlorination reaction.
Fig. S6 Long term testing of MIV-1Au/C1. Reaction Conditions: C$_2$H$_2$ flow rate = 77 mL/min, HCl/C$_2$H$_2$ = 1.13, Temp = 180°C, GHSV = 9800 /h. Deactivation rate was determined to be 0.72 /h.