Supporting information

Construction of Ru doped In$_2$O$_3$ hollow peanut-like structure for enhanced photocatalytic nitrogen reduction under solar light irradiation

Manh-Hiep Vu, Toan-Anh Quach, Trong-On Do*

Department of Chemical Engineering, Laval University, Québec (Québec), G1V 0A6, Canada

*E-mail: trong-on.do@gch.ulaval.ca

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Determination of ammonia

The ammonia concentration was spectrophotometrically measured by the indophenol blue method. Briefly, 1 mL of reacted solution was removed from the photoreactor. Next, 2 mL of 1M NaOH containing 5 wt% salicylic acid and 5 wt% sodium citrate, 1 mL of 0.05 M NaClO and 0.2 mL of 1 wt% C$_5$FeN$_6$Na$_2$O (sodium nitroferricyanide) were sequentially added to the solution. After 2h at ambient temperature, 2 mL of as-prepared solution was drawn out for UV-Vis measurement at a wavelength of 655 nm to determine the formation on indophenol blue (Figure S1). For the calibration of the concentration-absorbance curve, standard ammonia chloride solution with the concentration of 10, 20, 30, 40, 50, 100 µM in 10 vol% MeOH were used (Figure S.1), which contained the same concentration of MeOH as in the testing solution.
Figure S1: (a) UV-vis spectra for ammonium quantification using the indophenol-blue method with the concentration of 10, 20, 30, 40, 50, 100 µM in 10 vol% MeOH, respectively; (b) The calibration curve for ammonium quantification (NH$_4^+$ concentration versus absorbance at 655 nm).
Figure S2 The TEM images of MIL-68-In(Ru) precursors for 1h reaction.
Figure S3 The TEM images of MIL-68-In(Ru) precursors with 2% Ru doping.
Figure S4: X-ray diffraction spectra of MIL-68-In(Ru) and Ru-In$_2$O$_3$ hollow peanut samples
Figure S5: Representative EDX analysis collected on 2wt % Ru-In$_2$O$_3$ HPNs samples

EDX spectrum confirms that Ru-In$_2$O$_3$ HPNs mainly compose of Ru, In and O. The Cu signals are from the substrate
Figure S6: Survey XPS spectra of 2 wt% Ru-In$_2$O$_3$

XPS spectrum confirms that Ru-In$_2$O$_3$ HPNs mainly compose of Ru, In and O

<table>
<thead>
<tr>
<th>Element</th>
<th>Composition</th>
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<tbody>
<tr>
<td>In</td>
<td>39.81%</td>
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<tr>
<td>O</td>
<td>58.45%</td>
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<tr>
<td>Ru</td>
<td>0.56%</td>
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</tbody>
</table>
Figure S7: Photocatalytic NH$_3$ production rate of different transition metal dopants
Figure S8: (a) X-ray diffraction spectra and (b) SEM images of 2% Ru-In$_2$O$_3$ hollow peanuts after 6 cycles of photocatalytic test

Figure S9: EDX analysis collected on 2wt % Ru-In$_2$O$_3$ HPNs samples hollow peanuts after 6 cycles of photocatalytic test