

Electronic Supplementary Information

Iron-copper bimetallic nanoparticles supported on hollow mesoporous silica sphere: The effect of Fe/Cu ratio on heterogeneous Fenton degradation of dye

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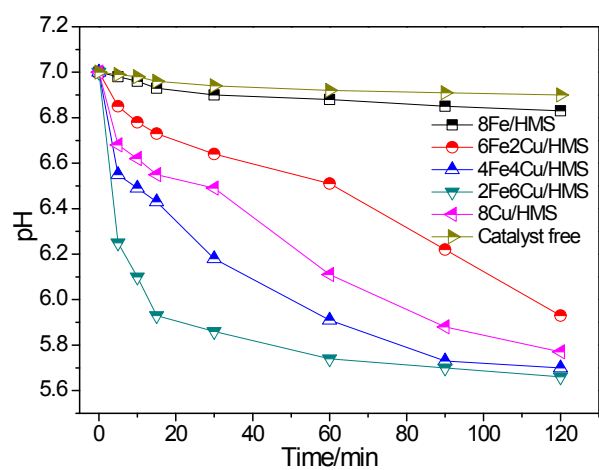


Fig. S1. The evolution of the pH during the degradation of Orange II with different catalysts at pH 7.0 with 27.4 mM H₂O₂, 1g/L catalyst dosage, 100 mg/L orange II , 30 °C, in 2 h reaction time.

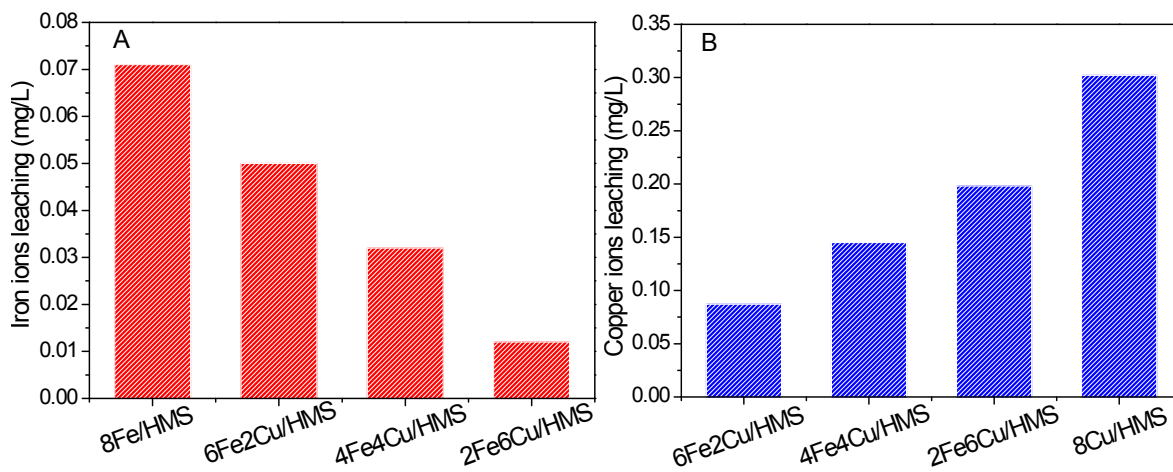


Fig. S2. The concentration of iron ions leaching (A) and copper ions leaching (B) in degradation of Orange II with different catalysts at pH 7.0 with 27.4 mM H₂O₂, 1g/L catalyst dosage, 100 mg/L orange II, 30 °C, in 2 h reaction time.

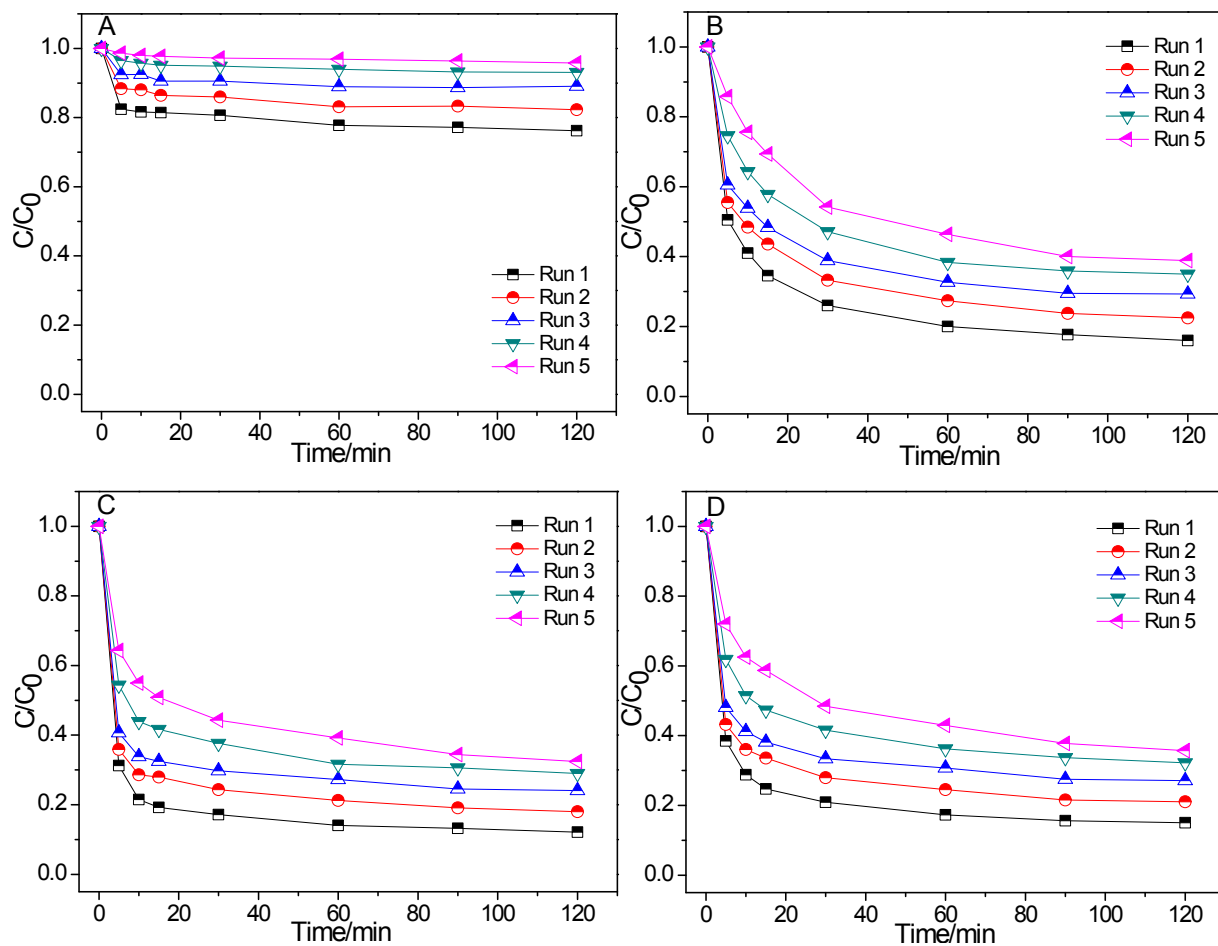


Fig. S3. Degradation of orange II in different batch runs in the (A) 8Fe/HMS, (B) 6Fe2Cu/HMS, (C) 4Fe4Cu/HMS and (D) 8Cu/HMS systems.

Table S1 HPLC-MS identified possible reaction products during orange II degradation

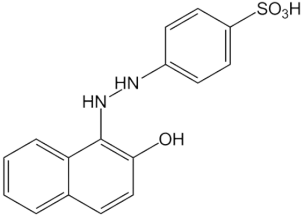

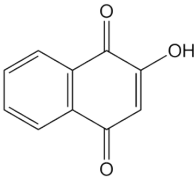
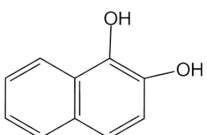
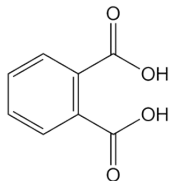
| Compound | Retention time | Chemical name | Chemical structure |
|----------|----------------|---|---|
| A | 4.7 min | 4-[2-(2-hydroxy-1-naphthalenyl)hydrazinyl]-benzenesulfonic acid |  |
| B | 2.1 min | 4-amino-benzenesulfonic |  |
| C | 3.4 min | 2-hydroxy- 1,4-naphthalenedione |  |
| D | 2.4 min | 1,2-naphthalenediol |  |
| E | 4.1 min | 1,2-benzenedicarboxylic |  |

Table S2 The capital cost of 2Fe6Cu/HMS to degradation of 1000 mg/L Orange II

| The cost of synthesis catalyst/g | | The cost of degradation of Orange II/L | |
|--|-------------|--|-------------|
| | Cost (yuan) | | Cost (yuan) |
| NH ₃ ·H ₂ O | 0.08 | Catalyst | 8.34 |
| CTAB | 0.49 | | |
| TEOS | 0.47 | | |
| Ethanol | 3.00 | | |
| FeSO ₄ ·7H ₂ O | 0.002 | H ₂ O ₂ | 0.05 |
| Cu(NO ₃) ₂ ·3H ₂ O | 0.028 | | |
| NaBH ₄ | 0.27 | | |
| Methanol | 3.00 | | |
| Electric Power | 1.00 | Total | 8.39 |
| Total | 8.34 | | |

Cost analysis

The capital cost of 2Fe6Cu/HMS to degradation of 1000 mg/L Orange II was list in Table S2. From the calculation, it can be seen that the synthesis of 1 g 2Fe6Cu/HMS would cost 8.34 yuan. During the degradation of 1 L 1000 mg/L Orange II with the catalyst dosage of 1 g/L and H₂O₂ dosage of 27.4 mM, the cost of catalyst and H₂O₂ would be 8.34 and 0.05 yuan, respectively. Totally, it would cost 8.39 yuan. Moreover, it can be observed that the final dye removal rate is 77.7% when conducted at Orange II concentration of 1000 mg/L. Therefore, the cost to degradation of 1 g Orange II is 10.80 yuan.