

Supporting Information

Fast synthesis of hierarchical yolk-shell copper hydroxysulfates at room-temperature with adjustable sizes

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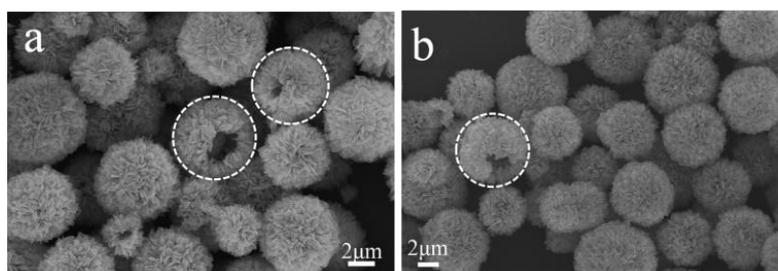


Fig. S1 SEM images of some yolk-shell spheres in low magnification.

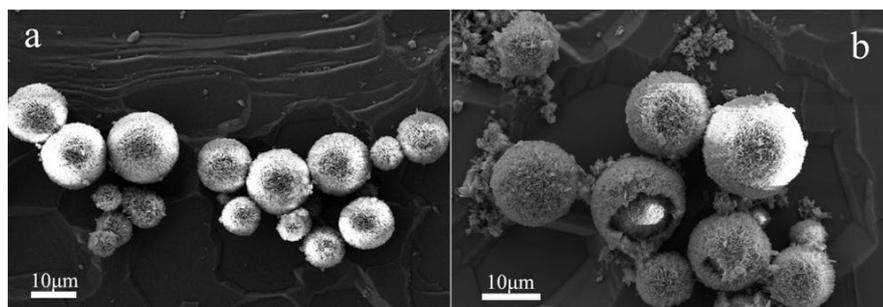


Fig. S2 (a) An overall SEM image of the yolk-shell products prepared using $C_3H_6(NH_2)_2$ with a concentration of 0.4 M, (b) SEM image of the broken yolk-shell products after vigorous ultrasonication.

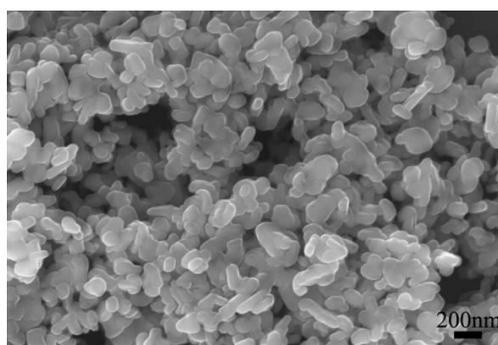


Fig. S3 SEM image of the products prepared using $Cu(NO_3)_2$ as initial solution.

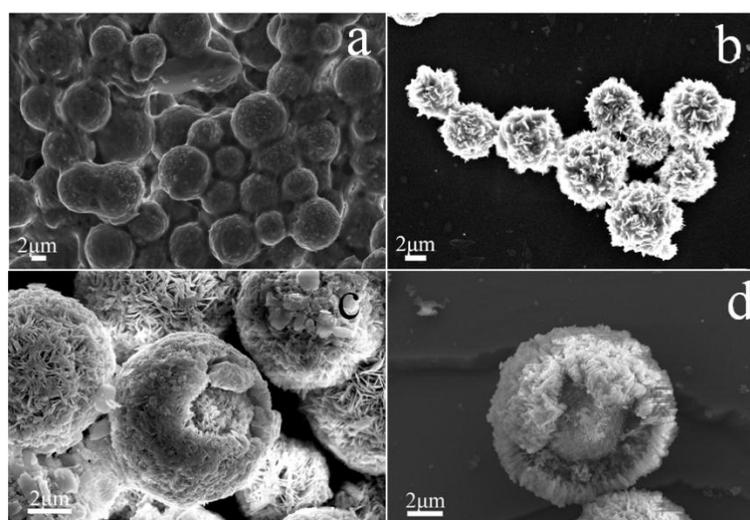


Fig. S4 SEM image of the products synthesized for different reaction time maintaining temperature at 5 °C, (a) 2 min; (b) 5 min; (c) 10 min; (d) 120 min. The products in Fig. S3c were destroyed by ultrasonic cell disruptor and in Fig. S3d were destroyed under vigorous ultrasonication.

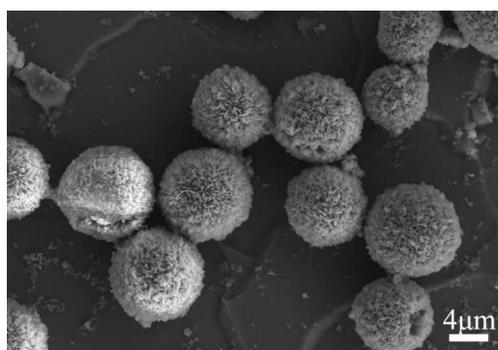


Fig. S5 SEM image of the yolk-shell products prepared in a large-scale experiment.

Table S1 Performance of the products for the oxidation of styrene by TBHP. (C_{bzh} , selectivity of benzaldehyde; C_{so} , selectivity of styrene oxide; C_{o} , selectivity of other by-products)

Reaction time	Conversion (%)	C_{bzh} (%)	C_{so} (%)	C_{o} (%)
3h	91.9	78.2	12.2	9.6
6h	93.6	76.9	12.4	10.7
9h	95.9	74.1	14.9	11.0

Reaction conditions: Styrene (1 mmol), catalyst (10 mg) and TBHP (5 mmol) dispersed in CH_3CN (5 mL) at 60 °C.

Table S2 Recyclability of the products for the oxidation of styrene by TBHP. (C_{bzh} , selectivity of benzaldehyde; C_{so} , selectivity of styrene oxide; C_{o} , selectivity of other by-products)

Run	Conversion (%)	C_{bzh} (%)	C_{so} (%)	C_{o} (%)
1	91.3	74.4	14.3	11.3
2	90.5	79.1	11.1	9.8
3	88.4	78.4	13.4	8.2
4	87.4	81.0	9.1	9.9
5	86.5	78.9	10.8	10.3

Reaction conditions: Styrene (1 mmol), catalyst (10 mg) and TBHP (5 mmol) dispersed in CH_3CN (5 mL) at 60 °C for 6 h.

Table S3 Performance of the products synthesized using different concentration of $\text{C}_3\text{H}_6(\text{NH}_2)_2$ for the oxidation of styrene by TBHP. (C_{bzh} , selectivity of benzaldehyde; C_{so} , selectivity of styrene oxide; C_{o} , selectivity of other by-products)

Products with different size	Conversion (%)	C_{bzh} (%)	C_{so} (%)	C_{o} (%)
7 μm	93.8	78.8	12.6	8.6
5.5 μm	94.1	75.3	13.7	11.0
4 μm	95.3	75.7	12.2	12.1

Reaction conditions: Styrene (1 mmol), catalyst (10 mg) and TBHP (5 mmol) dispersed in CH_3CN (5 mL) at 60 °C for 6 h.

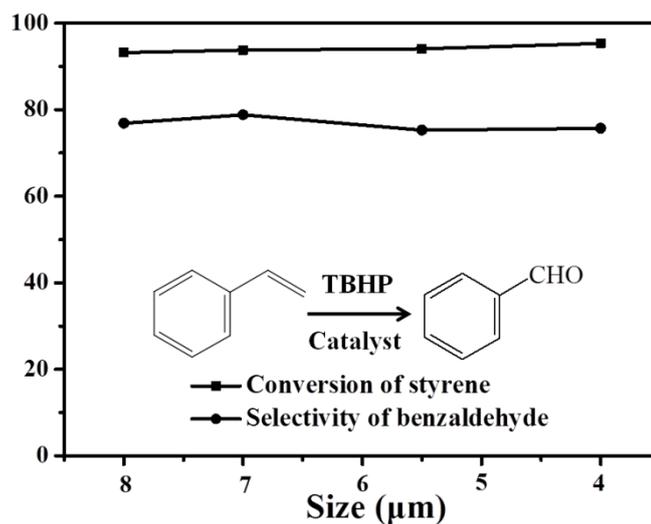


Fig. S6 Conversion of styrene, as well as the selectivity of benzaldehyde versus the size of the yolk-shell products catalyzed by yolk-shell copper hydroxysulfates. Reaction conditions: Styrene (1 mmol), catalyst (10 mg) and TBHP (5 mmol) dispersed in CH₃CN (5 mL) for 6 h.