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# Supporting Information

## Metal-organic framework derived $Co_3O_4$/C@$SiO_2$ yolk-shell nanoreactors with enhanced catalytic performance

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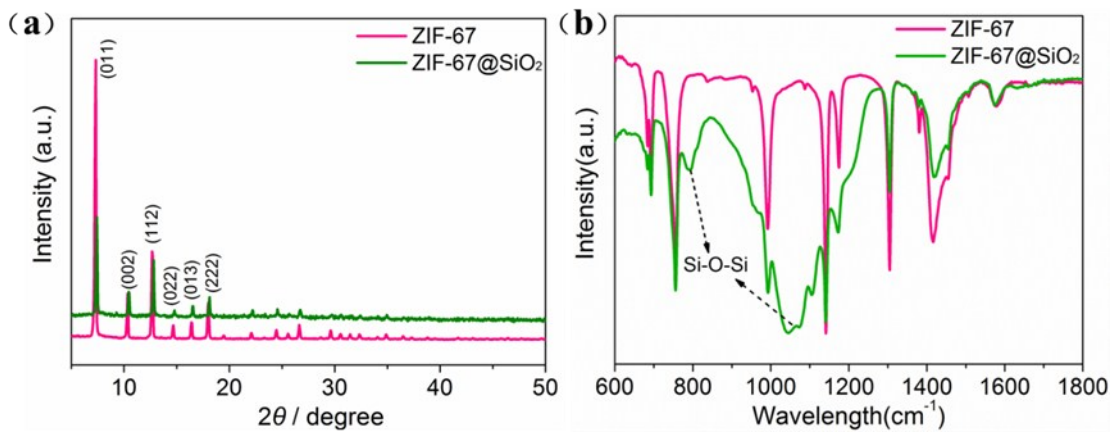


Fig. S1 The powder XRD patterns (a) and FTIR spectra (b).

**Synthesis of ZIF-67 nanoparticle**

ZIF-67 dodecahedron nanoparticle was obtained according previously reported. In a typical experiment, 5.4 g of 2-MeIm was added to 50 mL of DI water with stirring for 10 min. Then 0.35 g of $Co(NO_3)_2 \cdot 6H_2O$ dissolved in 50 mL DI water was added into the above solution with stirring for 3 h at room temperature. The resulting purple precipitate was collected by centrifugation with 8000 r/min for 10 min and washed with DI water and ethanol for three times, respectively. Finally, the purple powder was dried under vacuum 6 h at 80 ˚C.

**MOF derived $Co_3O_4$/C nanoparticles**

The same procedure was used to prepare YSCCSs except that ZIF-67@$SiO_2$ was used in place of ZIF-67.

**$Co_3O_4$ nanoparticles**

500 mg of $Co(NO_3)_2 \cdot 6H_2O$ and 125 mg of sodium citrate were dissolved in 50 ml of DI water, then 1.4 g of NaOH was added above solution and stirred for 2 h to form a $Co(OH)_2$ colloidal dispersion. The generated $Co(OH)_2$ was collected and washed for further use. 50 mg of $Co(OH)_2$ was heated at 550 ˚C in air atmosphere with a ramp rate of 5 ˚C $min^{-1}$, then cooled to room temperature to get $Co_3O_4$ nanoparticles.

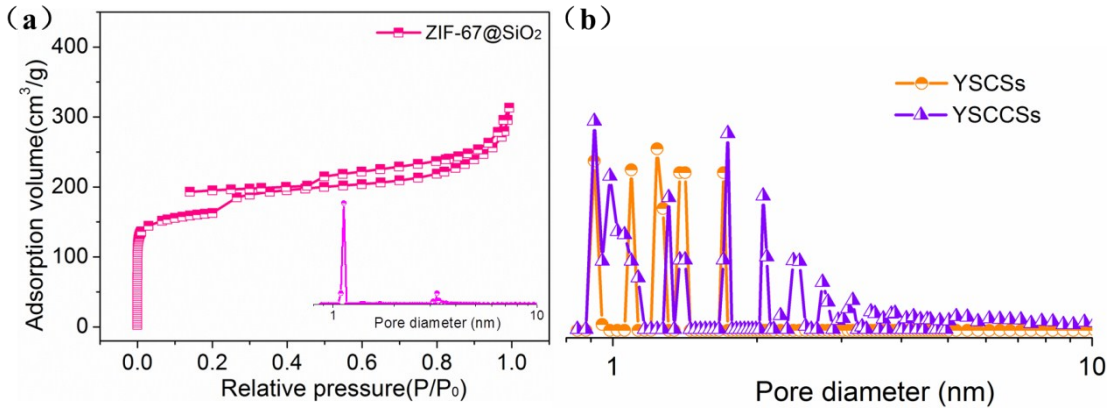


Fig. S2 $N_2$ sorption isotherms of ZIF-67@$SiO_2$ and pore size distribution.

Table S1 The surface area and pore volume of ZIF-67, YSCCSs and YSCSs.

| **Material** | **Surface Area ($m^2$ $g^{-1}$)** | **Pore Volume ($cm^3$ $g^{-1}$)** |
|---|---|---|
| ZIF-67@$SiO_2$ | 566.5 | 0.46 |
| YSCCSs | 194.6 | 0.23 |
| YSCSs | 173.4 | 0.55 |

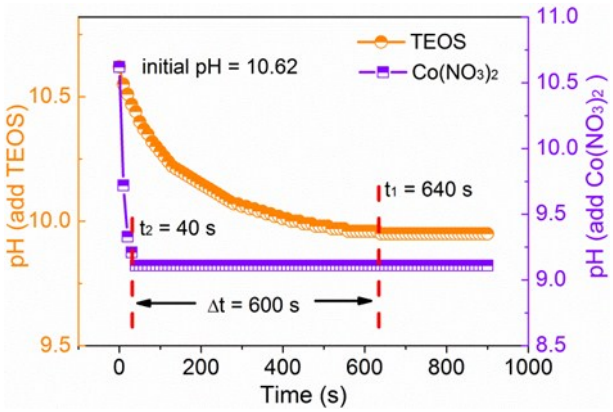


Fig. S3 The pH value of changing when added TEOS and $Co(NO_3)_2$ to the 2-MeIm solution, respectively.

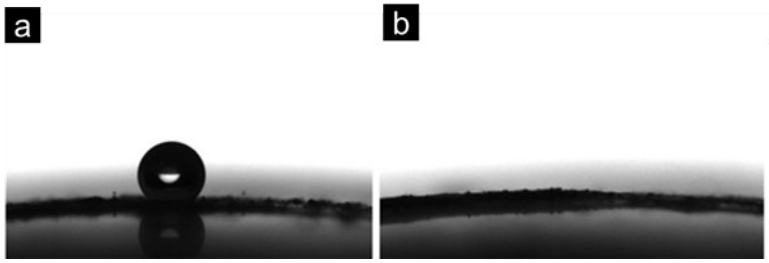


Fig. S4 Photographic images of water contact angles on the surfaces of ZIF-67 derived $Co_3O_4$/C and YSCCSs.

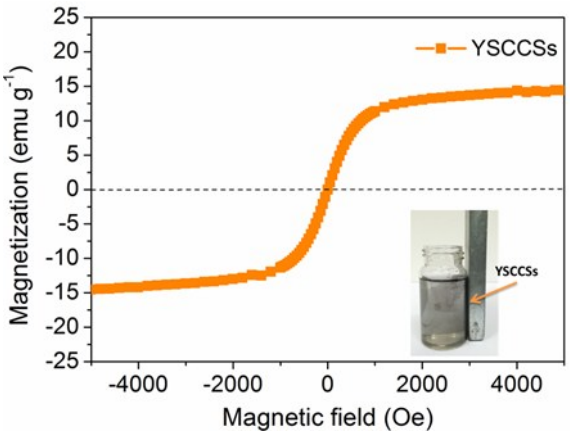


Fig. S5 The characterization the magnetic properties of YSCCSs

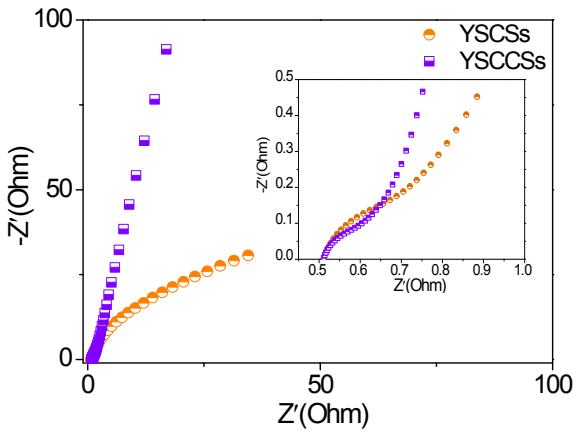


Fig. S6 Electrochemical impedance spectroscopy (EIS) spectra of YSCSs and YSCCSs.

The EIS measurements were carried out from 100 MHz to 0.01 Hz at an overpotential of 250 mV. The semicircles in the high- and low-frequency range of the Nyquist plot are related to the electrocatalytic kinetics and a lower value corresponds to a faster reaction rate.