Supplementary Information

A simple way to prepare Au@polypyrrole/Fe₃O₄ hollow capsules with high stability and their application in catalytic reduction of methylene blue dye

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**Fig. S1** Energy-dispersive X-ray absorption (EDX) spectroscopy of the Au@PPy/Fe₃O₄ hollow capsules. The signal of Si raise from detector of TEM, while Cu is attributed to the sample grid film. It is necessary to mention that the signal of C partly raise from PPy shell and partly raise from grid film.
Fig. S2 High-resolution Fe 2p XPS spectrum of Au@PPy/Fe$_3$O$_4$ hollow capsules.
Fig. S3 Magnetization curves at 5 K of Au@PPy/Fe₃O₄ hollow capsules. The magnetization at 5 K is 31.6, 39.3 and 40.4 emu/g for samples prepared with 10, 30 and 50 mg FeCl₂·4H₂O, respectively.
**Fig. S4** The rate constant $k$ of precursor PS/Au composites estimated by the slopes of straight lines of $\ln(A_t/A_0)$ vs. reaction time.
**Fig. S5** UV-Vis spectra of the MB dye and NaBH$_4$ mixture in absence of catalysts at different times. Inset shows the rate constant $k$ estimated by the slopes of straight lines of ln($A_t/A_0$) vs. reaction time.
**Fig. S6** The rate constant $k$ estimated by the slopes of straight lines of $\ln(A_t/A_0)$ vs. reduction time using 0.1 mg catalysts at different reused circles: (a) 2$^{nd}$; (b) 3$^{rd}$; (c) 4$^{th}$; and (d) 5$^{th}$. Here, the time that catalytic reaction started is set as the beginning time ($t = 0$).