Electronic Supplementary Information

A Highly Reactive and Enhanced Thermal Stability Nanocomposite Catalysts Based on Au Nanoparticles Assembled in the Inner Surface of SiO_2 Hollow Nanotubes

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Table S1

Characterization data of the catalysts calcination at different temperatures

Catalysts	BET surface area (m^2/g)	Pore diameter (nm)	V_{total} (cm^3/g)	$k/10^3$ (s^{-1})
450 °C	108.6	15.9	0.4812	3.6
550 °C	68.1	19.7	0.2788	5.1
650 °C	62.5	24.2	0.3248	2.9

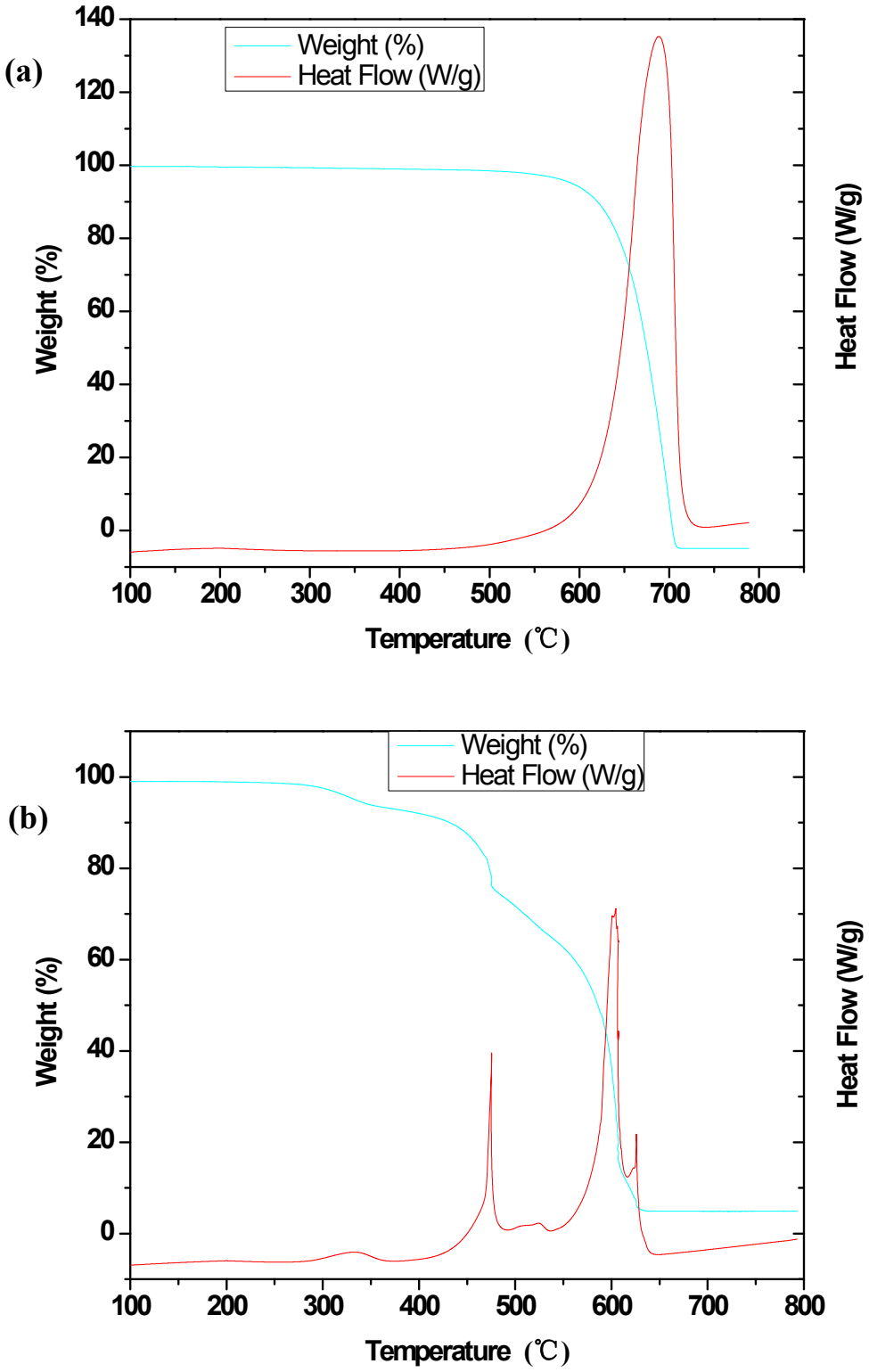
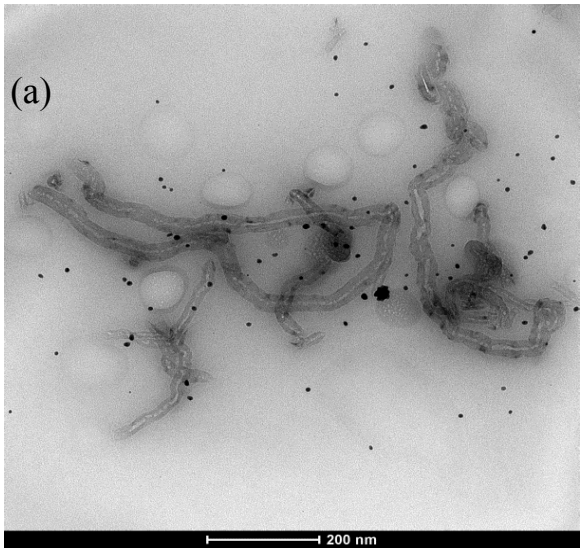


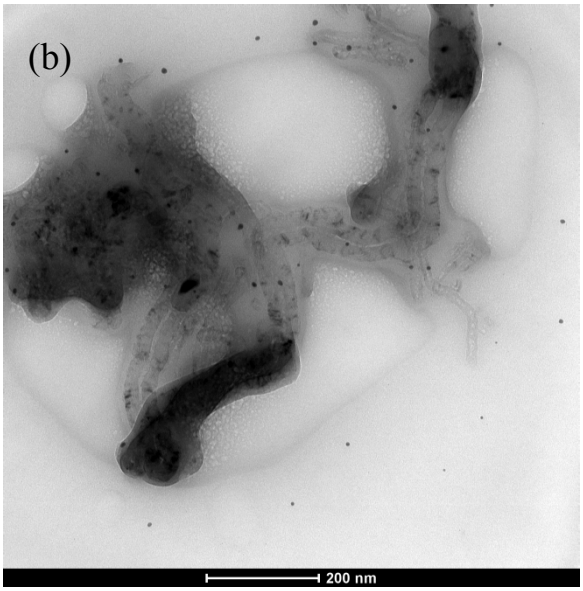
Fig. S1. TGA curves for (a)pure MWCNTs samples (b)modified MWCNTs by nitration mixture, APTES and PVP

From Fig.S1(a), it can be clearly seen that the pure MWCNTs started to decompose at the temperature of 504°C, and a large number of MWCNTs decomposed at 580°C. However, the properties of MWCNTs have changed after continuously modified by nitration mixturem, APTES and PVP. It can be obtained from Fig. S1 (b), the sample released a large amount of heat at 473 °C, inferred the burning of PVP and other organics. In addition, a large amount heat was released from 550°C, suggested that the MWCNTs was decomposed. A small amount heat was released at 620 °C, which suggested partial crystal carbon was decomposed.

It can be concluded that the pure MWCNTs have a relative high decompose temperature. It is difficult to form hollow tubes structure at a low temperature. Luckily, the decompose temperature decreased after modified. As a result, the hollow tubes structure could be fabricated at a relative low temperature resulting from smaller Au nanoparticles. At the same time, the modified MWCNTs were functionalized with some functional groups, which offered a convenient way to the sequential treatments.

Taking into account that the amount of Au NPs is an important parameter, the interaction between the injected amount of polyaniline (PANI) and the deposited amount of Au on the CNTs were investigated (Fig. S2).


(a)
200 nm


(b)
200 nm

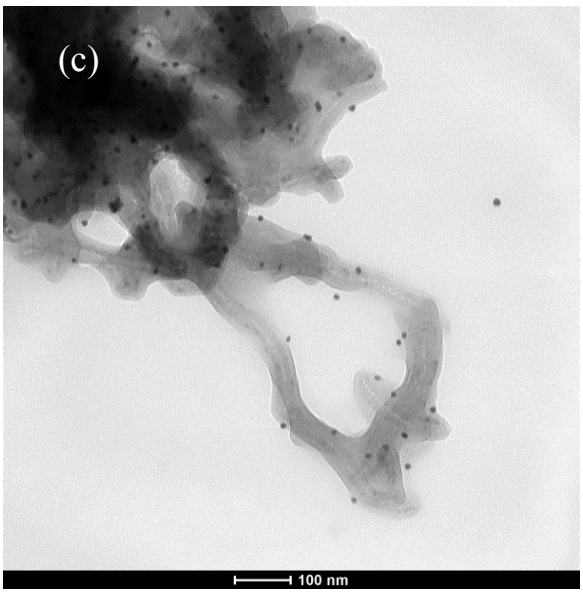

(c)
100 nm

Fig. S2. TEM images of Au/CNTs (a) without polyaniline (PANI), (b) with 3.75 g polyaniline (PANI), (c) with 7.5 g polyaniline (PANI).

Without the addition of PANI, most of Au run off and only a very small amount of Au nanoparticles were deposited on the CNTs (Fig. S2a). However, when 3.75 g PANI was injected during the reaction, the result Au/CNTs was loaded a lot amount of Au NPs and only a few Au NPs run off at the solution (Fig. S2b). As expected, a large amount of Au nanoparticles were deposited when double of PANI (7.5 g) was added (Fig. S2c). To explain this, it could be noted that the surface of PANI was positive charge, while the Au nanoparticles were negative charge. In this way, after the function, the intense interaction between PANI and Au NPs occurred due to the electrostatic-attraction. At the same time, a very interesting phenomenon was observed, when PANI was not added to the reaction, CNTs with clearly hollow nanotubes. However, the tubes become indistinct when the PANI was added (Fig.S2b and c). Moreover, as the amount of PANI increased, the tubes become more and more indistinct (Fig. S2), which may be attribute to PANI absorbed and enwind on the surface of CNTs.

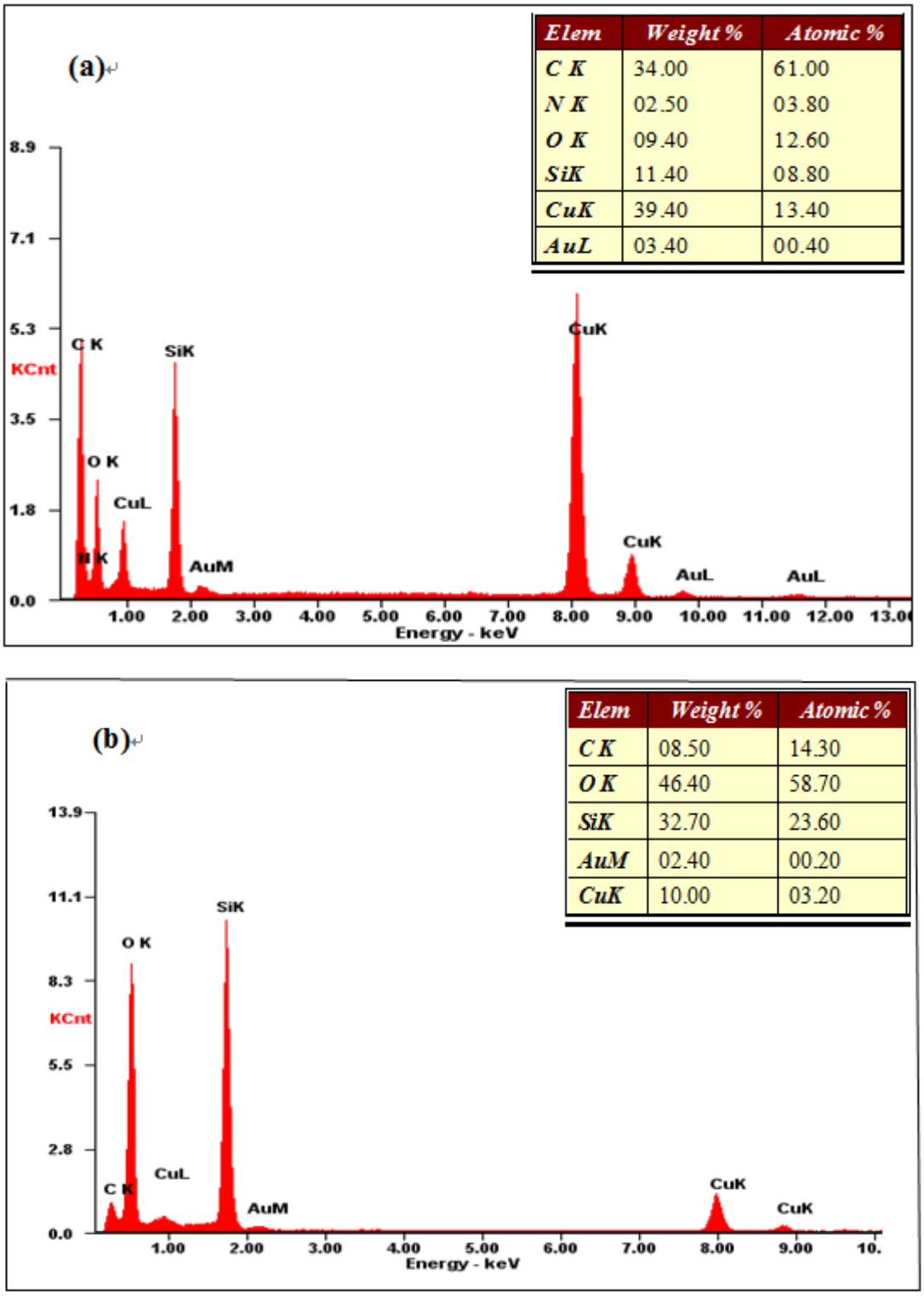


Fig. S3. EDX analysis of (a) SiO_2/Au/CNTs, (b) HTMS SiO_2/Au treated at 650 °C for 4 h.

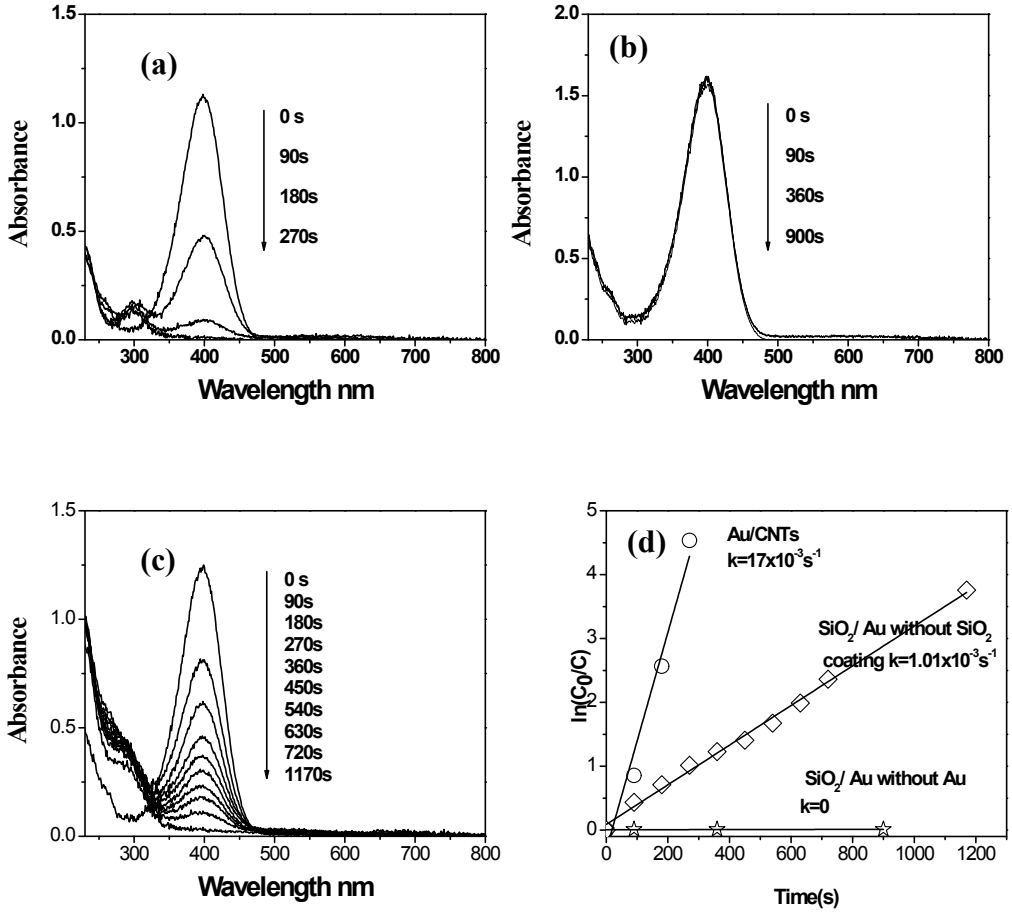


Fig. S4. Successive UV-visible absorption spectra of p-NPh solution reduced by $NaBH_4$ in the presence of (a) Au/CNTs, (b) SiO_2/ CNTs calcined at 550 °C for 4 h, (c)SiO_2/ Au without SiO_2 coating calcined at 550 °C for 4 h (d) Comparison of rate constants of the catalytic reduction reaction of p-NPh catalyzed by the samples.