Electronic Supplementary Material (ESI) for Inorganic Chemistry Frontiers.

A facile self-template and carbonization strategy to fabricate nickel nanoparticles supported N-doped carbon microtubes

Jianping Wang[a], Min Zhang[a]*, Teng Miao[a], Yang Ling[a], Qiong Wen[a], Jing Zheng[a]*, Jingli Xu[a], Tasawar Hayat[b], Njud S. Alharbi[c]

College of Chemistry and Chemical Engineering, Shanghai University of Engineering Science, Shanghai 201620, PR China Email: *zhangmin@sues.edu.cn; kkzhengjing707@163.com*.

Supporting information

Synthesis of PPy@PDA and NCMTs-900

50 mg of MoO_3@PPy composites were uniformly dispersed in a mixture solution of 25 mL absolute ethanol and 15 mL deionized H_2O by ultrasonication. Then, 5 mL of ammonia aqueous solution was added and stirring for 5 min. After that, 45 mg of dopamine was added into the above solution stirring for 16 h at room temperature. Subsequently, the product was collected by centrifugation and washed with deionized water and ethanol several times and dried at 60°C. Lastly, the obtained PPy@PDA was burned in a tube furnace under an N_2 atmosphere at 900°C for 5 h to obtain the NCMTs-900.

Synthesis of NGCMTs-900

Ni/NCMTs-900 was dissolved into 20% HNO_3 and shaked 24 h to etch nickel NPs. After acid treatment, NGCMTs-900 was collected.

Catalytic activity of NGCMTs-900

Typically, 5 mg $NaBH_4$ was mixed with the freshly prepared 4-Nitrophenol aqueous solution (0.1 mM, 3 mL). Afterwards, NGCMTs-900 (1 mg) was added into the reaction mixture. The reaction process was monitored by UV–vis spectroscopy.

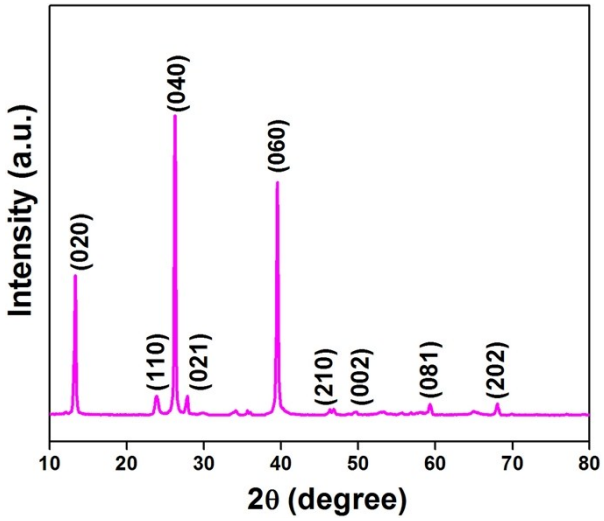

Fig. S1. XRD pattern of MoO_3 microrods.

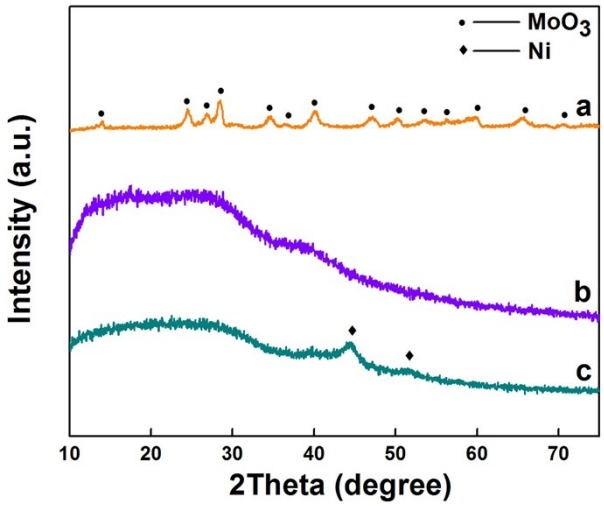

Fig. S2. XRD patterns of MoO_3@PPy (a), PPy@PDA-Ni^{2+} (b) and Ni/NCMTs-500 (c).

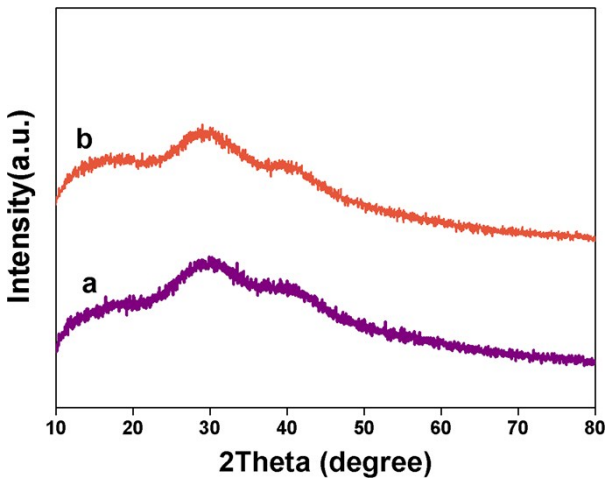

Fig. S3. XRD patterns of PPy@PDA-Ni^{2+} synthesizing at 0.5 mL ammonia (a) and 2 mL ammonia (b).

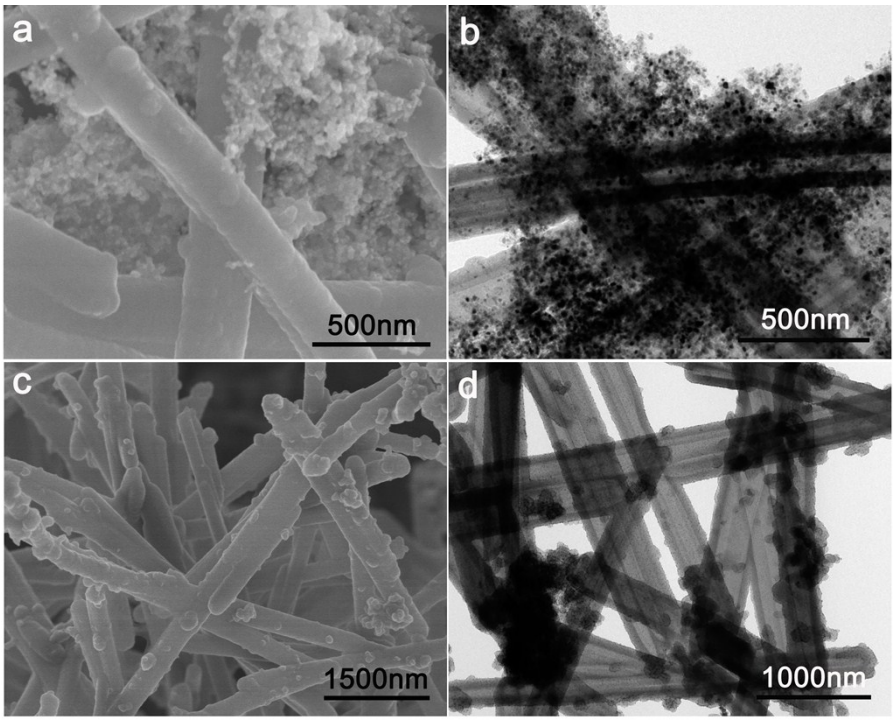

Fig. S4 SEM and TEM images of Ni/NCMTs-0.5 (a, b) and Ni/NCMTs-2 (c, d).

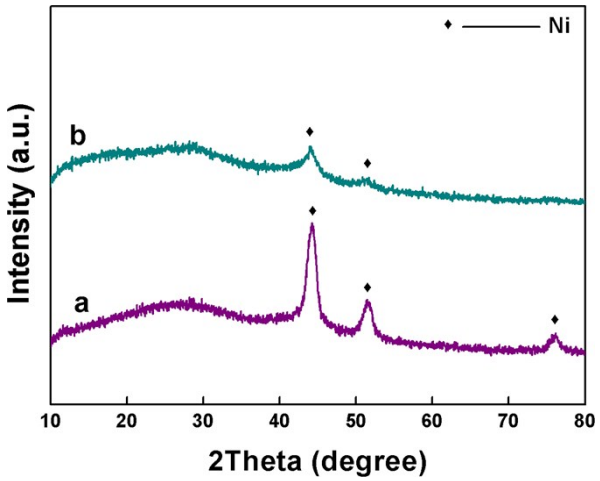

Fig. S5 XRD pattern of Ni/NCMTs-0.5 (a) and Ni/NCMTs-2 (b).

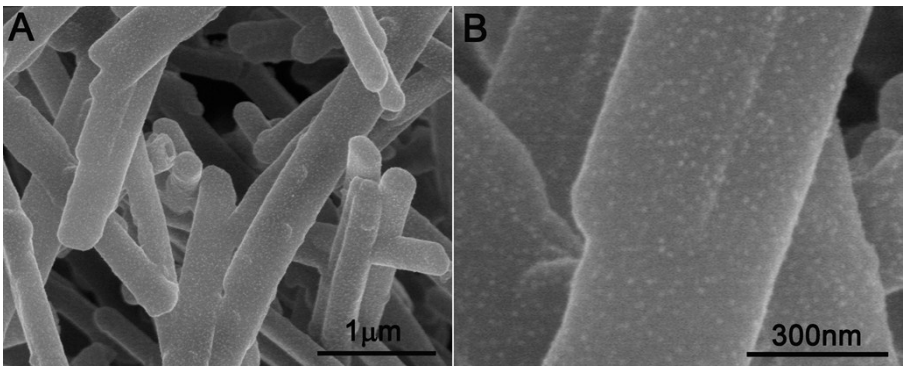

Fig. S6 SEM and TEM image of PPy@RF-Ni^{2+} (a) and carbonized product (b).

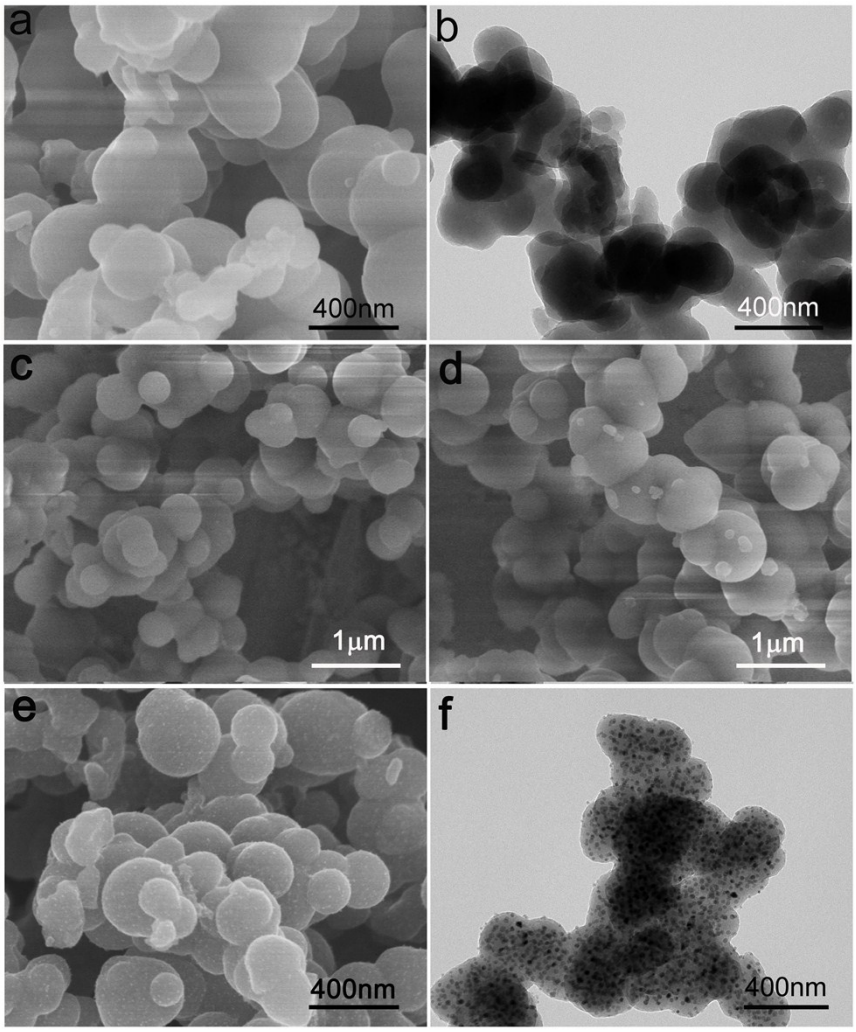

Fig. S7 SEM and TEM images of PDA-Ni^{2+} (a, b) prepared at 2 mL ammonia, SEM and TEM images of carbonized product (e, f); SEM images of PDA-Ni^{2+} prepared at 0.5 mL (c) and 5 mL (d) ammonia.

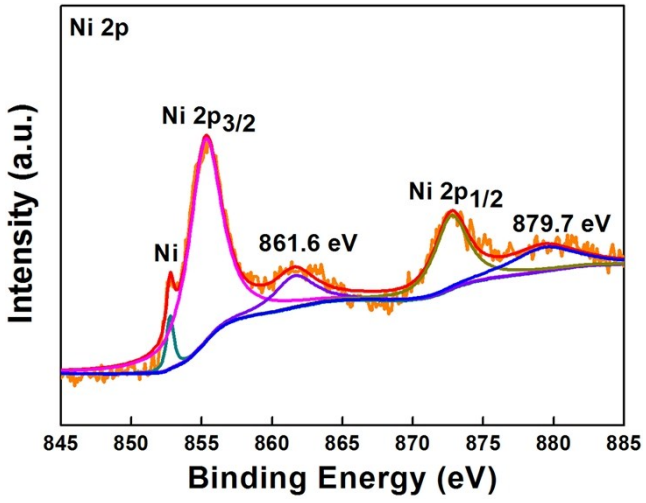

Fig.S8 Deconvoluted XPS spectra of Ni 2p monitored in Ni/NCMTs-500.

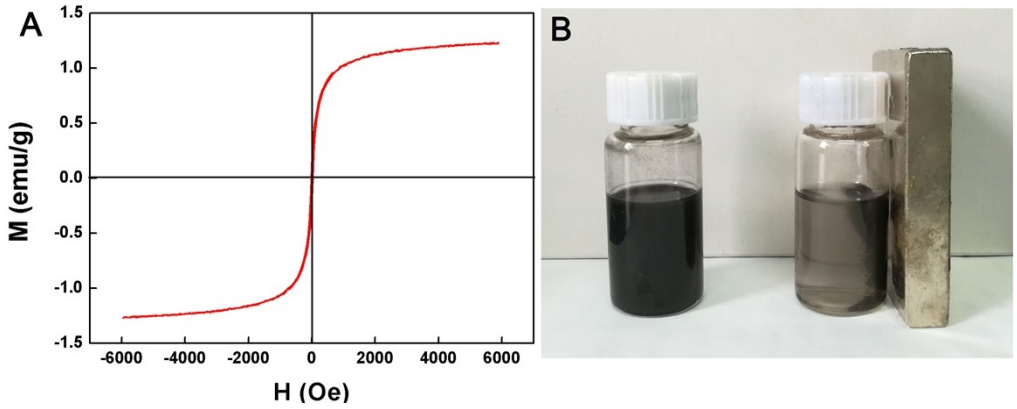

Fig.S9 Magnetic hysteresis curves of Ni/NCMTs-500.

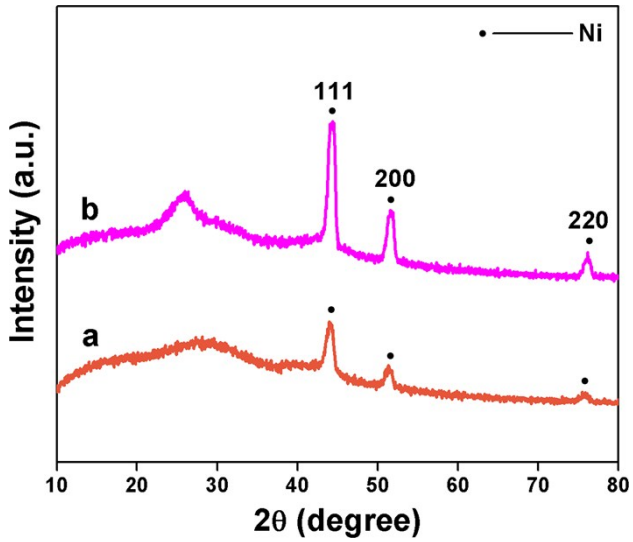

Fig. S10 X-Ray diffraction patterns of Ni/NCMTs-700 (a) and Ni/NCMTs-900 (b).

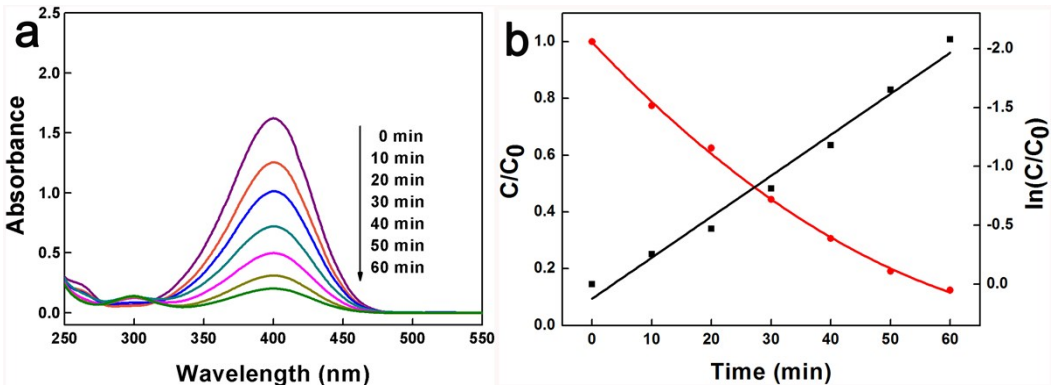

Fig.S11 (a) UV-vis spectra of NGCMTs-900 catalyzed 4-NP to 4-AP after 60 minutes; (b) C/C_0 and $\ln(C/C_0)$ versus time for the reduction of 4-NP over 1.0 mg NGCMTs-900 catalysts, the ratio of 4-NP concentration (C_t at time t) to its initial value C_0 is directly represented by the relative intensity of the respective absorption peak at 400 nm.

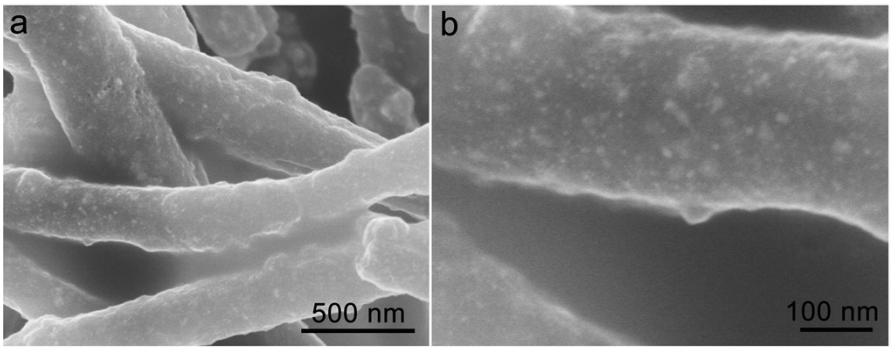

Figure 2. SEM images of Ni/NCMTs-500 for the reduction of 4-nitrophenol after recycled 5 times.

Table.S1 ICP data of different samples and comparison for the reduction of 4-NP.

Samples	Ni content (μg/mg)	K ($\times10^{-3}s^{-1}$)	κ ($mg^{-1}s^{-1}$)
Ni/NCMTs-500	41.0	5.7	0.139
Ni/NCMTs-700	122	8.7	0.071
Ni/NCMTs-900	131	4.2	0.032

Table.S2 Comparison of the reduction of 4-NP with different catalysts.

Samples	**Type**	**k($\times10^{-3}$ s^{-1})**	**κ($\times10^{-3}mg^{-1}s^{-1}$)**	**References**
Ni/NCMTs-500	Micro-nanotube	5.7	139	This work
Ni/NCMTs-700	Micro-nanotube	8.7	71	This work
Ni/NCMTs-900	Micro-nanotube	4.2	32	This work
Ni/SNTs(23.0 wt%)	Nanotube	84	91	1
Ni/SNTs(23.0 wt%)	Nanotube	84	91	1
Ni/p (AMPS)	Hydrogel	0.9	0.15	2
Ni/MC-550	Nanotube	1.51	338	3
Ni/MC-750	Nanotube	6.26	5640	3
Ni/MC-950	Nanotube	2.40	2424	3
RGO-Ni	Nanosheets	0.25	0.04	4

1. S. Zhang, S. Gai, F. He, S. Ding, L. Li and P. Yang, *Nanoscale*, 2014, **6**, 11181-11188.
2. N. Sahiner, H. Ozay, O. Ozay and N. Aktas, *Applied Catalysis A: General*, 2010, **385**, 201-207.
3. Y. Yang, Y. Ren, C. Sun and S. Hao, *Green Chemistry*, 2014, **16**, 2273-2280.
4. Z. Ji, X. Shen, G. Zhu, H. Zhou and A. Yuan, *Journal of Materials Chemistry*, 2012, **22**, 3471-3477.