Supporting Information

Formation of One-dimensional Hierarchical MoO_2@C-Ni/CoNi hybrids as highly efficient catalysts and protein adsorbents

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Synthesis of hierarchical Ni-$CoMoO_4$

618 mg of nickel acetate and a certain amount of cobalt chloride hexahydrate were dispersed in a mix solution of 20 mL ethanol and 20 mL water. Then, 75 mg as-prepared MoO_3 was added. Finally, the mixture above was transferred into a three-necked round bottom flask under stirring at 90 ℃ for 5 h. After it cooled to room temperature naturally, the precipitates were separated by centrifugation, washed with distilled water and absolute ethanol, and dried in air. The mass ratios of nickel and cobalt ions are 8:1, 8:2, 8:4 and 8:8, respectively. As mentioned above, the obtained samples, with different mass rations of nickel ions and cobalt ions, are named Ni-$CoMoO_4$-1, Ni-$CoMoO_4$-2, Ni-$CoMoO_4$-4 and Ni-$CoMoO_4$-8, respectively.

Synthesis of hierarchical Ni-$CoMoO_4$@PDA-Ni^{2+}

An extended Stöber method was applied to coat the PDA-Ni^{2+} outer layer on the surface of Ni-$CoMoO_4$. Specifically, 50 mg of as-prepared Ni-$CoMoO_4$ was dispersed in a liquid of 25 mL of ethanol and 15 mL of deionized water and 1 mL of 30% ammonia solution, followed by the addition of dopamine (15 mg) and $NiCl_2 \cdot 6H_2O$ (37.6 mg). After stirring for 24 h at room temperature. the products of $NiMoO_4$@PDA-Ni^{2+} were collected and washed three times with distilled water and ethanol, and dried at 60 ℃ for 12 h.

Synthesis of hierarchical MoO_2@C-CoNi

The as-prepared $NiMoO_4$@PDA-Ni^{2+} powder were burned in a tube furnace under

an N_2 atmosphere at 500 ℃ for 5 h, the obtained black powder was MoO_2@C-CoNi.

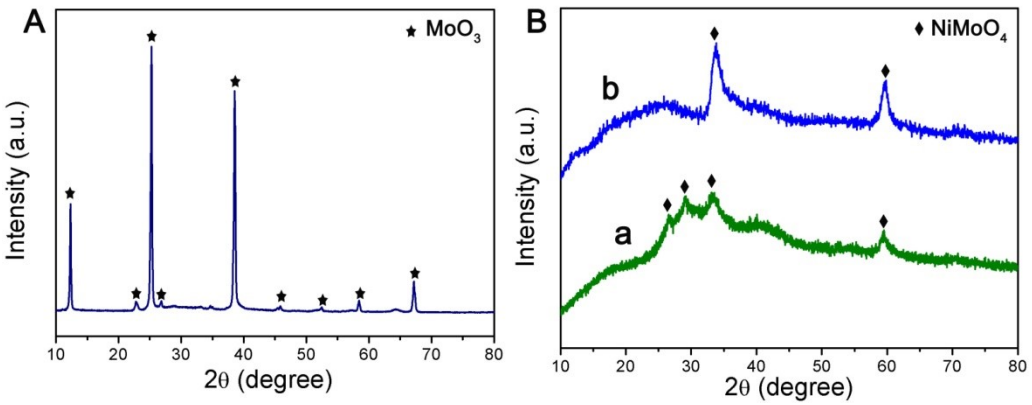

Figure S1. XRD pattern of (A)MoO_3, $NiMoO_4$ (B-a) and $NiMoO_4$@PDA-Ni^{2+} (B-b).

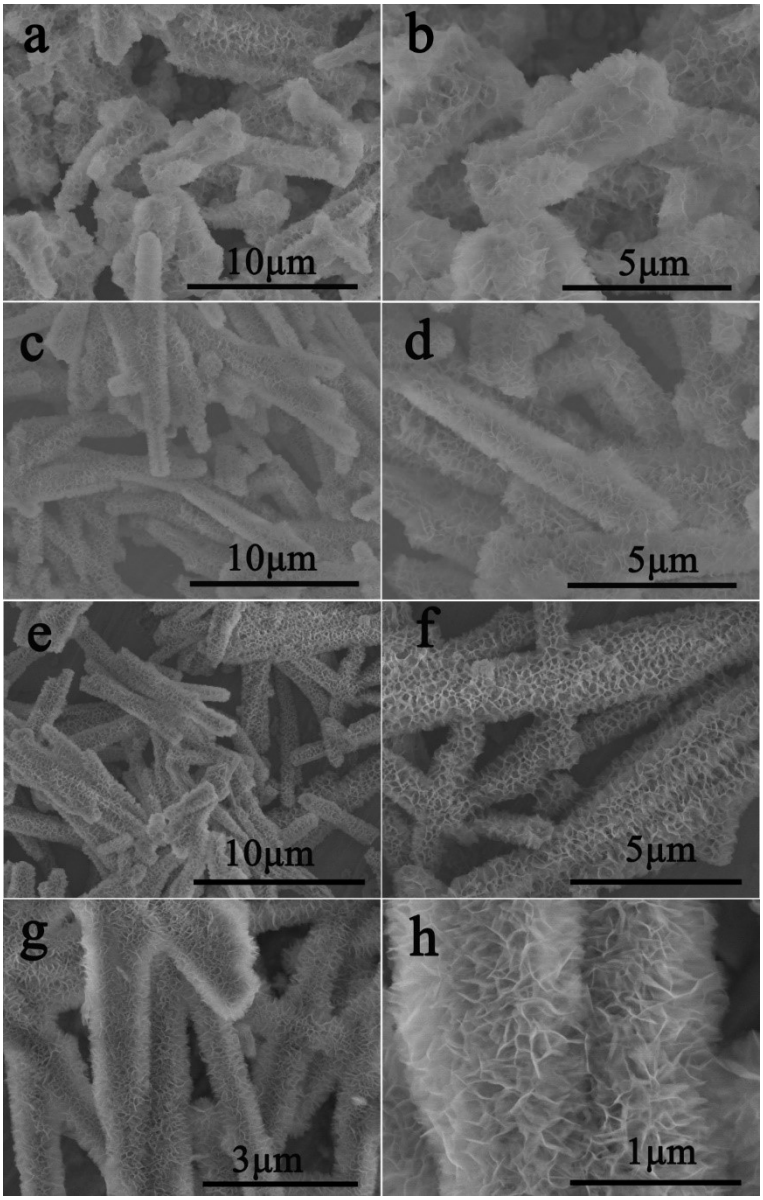

Figure S2. SEM images of Ni-$CoMoO_4$-1(a, b), Ni-$CoMoO_4$-2(c, d), Ni-$CoMoO_4$-4(e, f) andNi-

$CoMoO_4$-8(g, h).

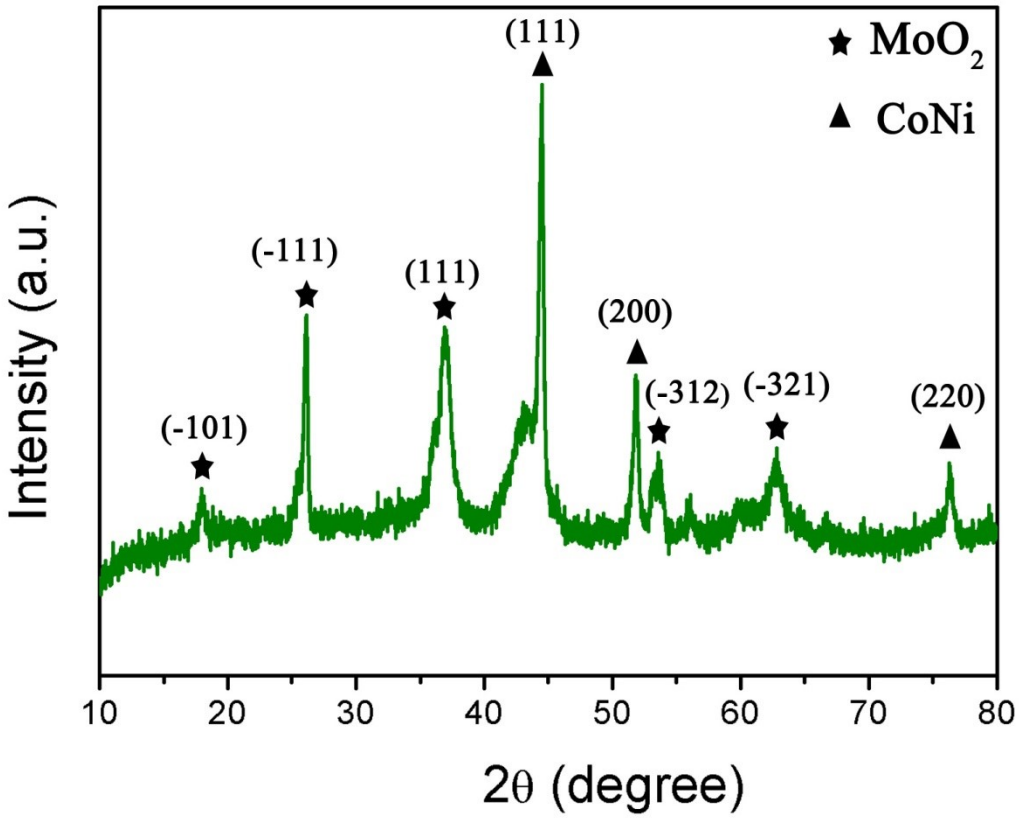

Figure S3. XRD pattern of MoO_2@C-CoNi-1.

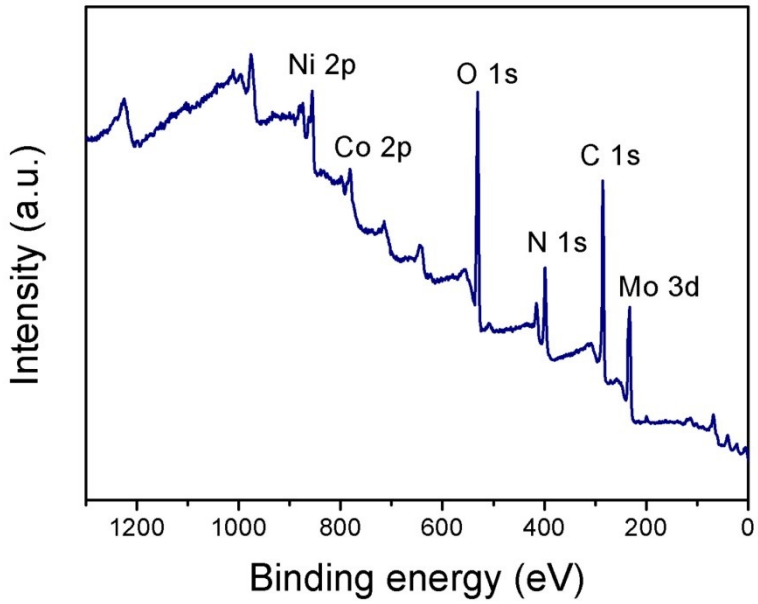

Figure S4. The XPS spectrum of MoO_2@C-CoNi-1.

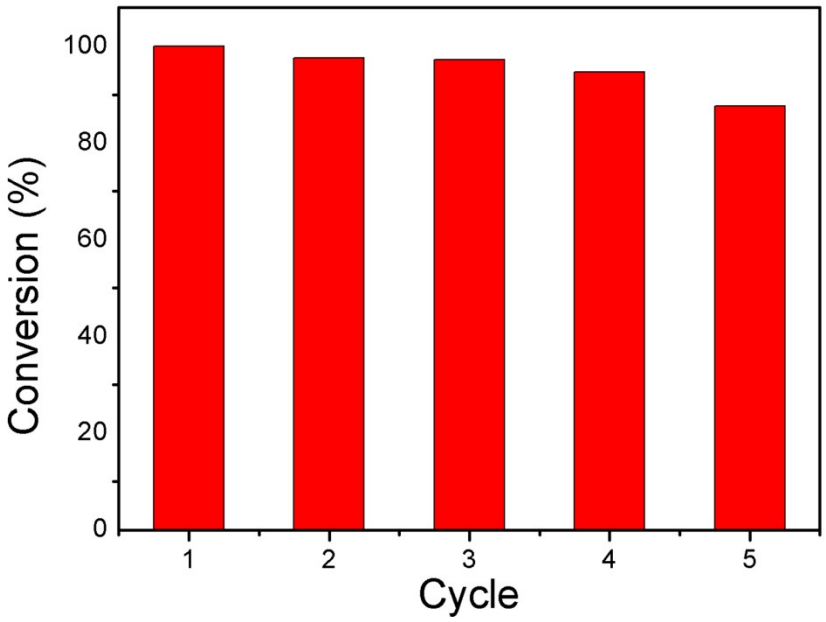

Figure S5. The recyclability of the MoO_2@C-Ni as the catalyst for 4-NP.

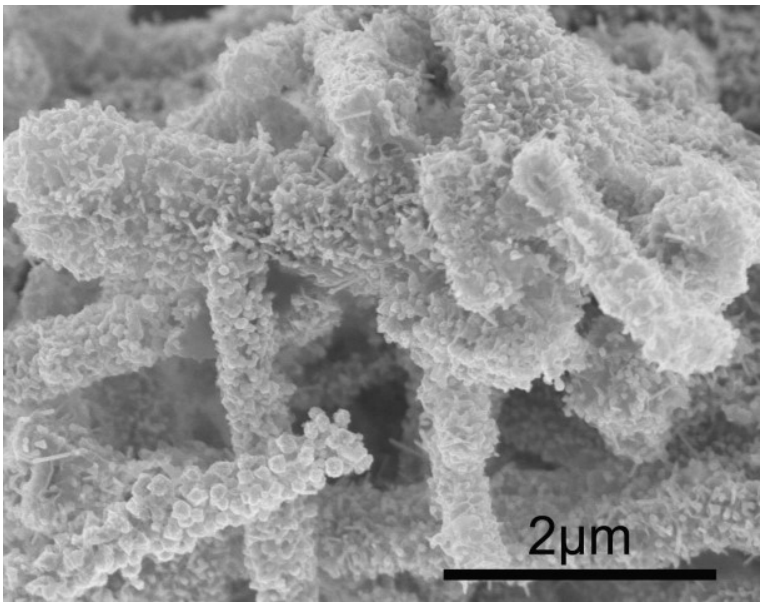

Figure S6. SEM images of MoO_2@C-Ni after five catalysis.

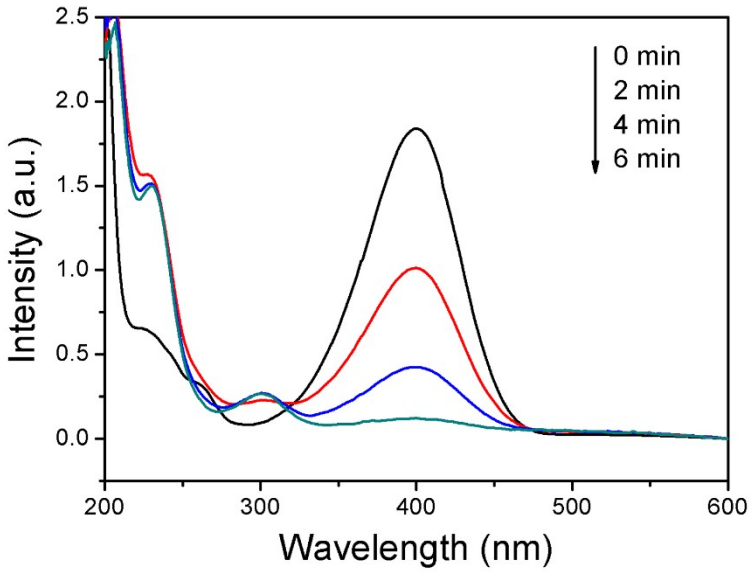

Figure S7. UV/Vis absorption spectra of the reaction mixture in the reduction of p-nitrophenol (0.1 mM) by $NaBH_4$ in the presence of MoO_2@C-CoNi-1 (1 mg).

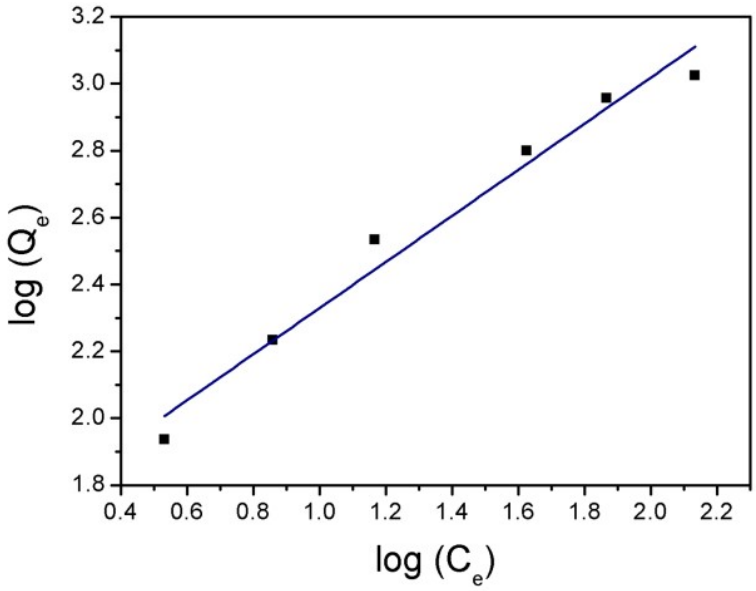

Figure S8. Linear fitting of adsorption isotherms plots based on Freundlich model.

Table S1 the estimate of Langmuir model and Freundlich model

Langmuir			Freundlich		
Q_m	K_d	R^2	K_F	n	R^2
1489.96	0.0536	0.99211	43.69	1.45	0.96902