Electronic Supplementary Information (ESI)

Eco-friendly synthesis of N,S co-doped hierarchical nanocarbon as highly efficient metal-free catalyst for reduction of nitroarenes

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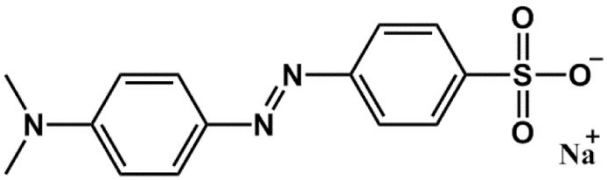

Figure S1. Chemical structure of the sulphonate-based anionic dye-methyl orange (MO). The chemical formula of MO is $C_{14}H_{14}N_3O_3SNa$. The negatively charged $(C_{14}H_{14}N_3O_3S)^{-1}$ can be intercalated into the interlayers of LDH as counter ions.

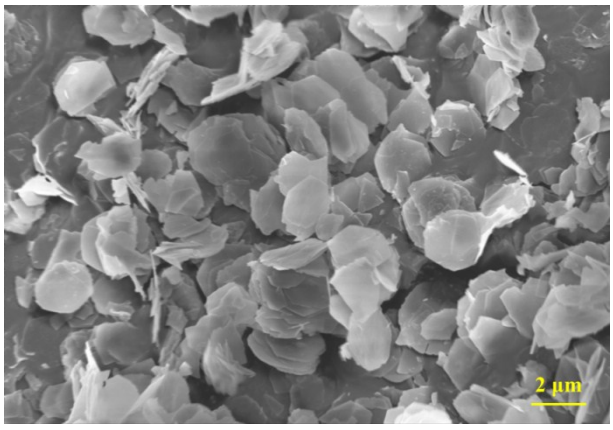

Figure S2. Low magnification SEM image of Mg-Al LDH.

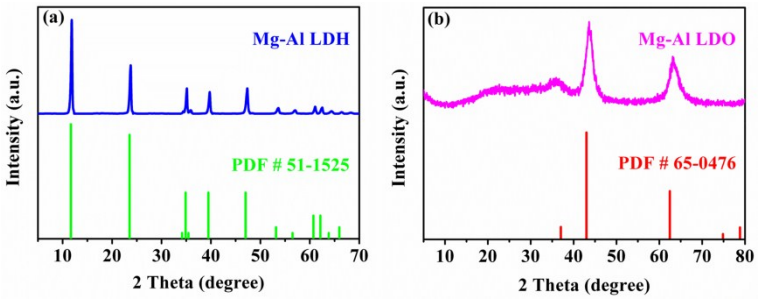

Figure S3. PXRD patterns of Mg-Al LDH (a) and Mg-Al LDO (b).

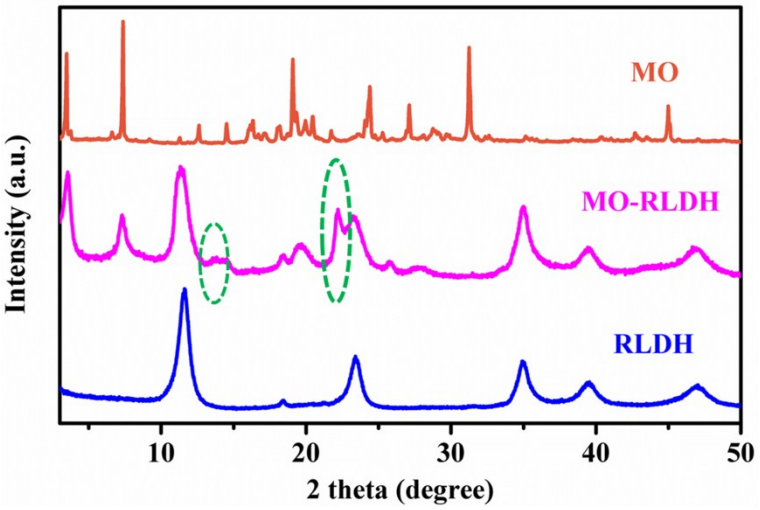

Figure S4. PXRD patterns of MO, RLDH and MO-RLDH.

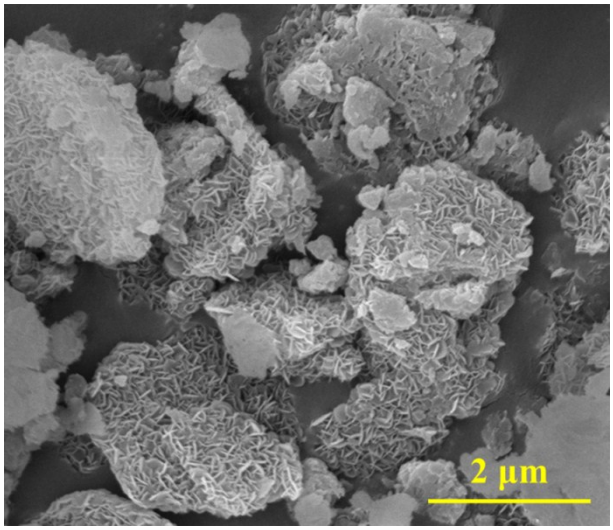

Figure S5. Low magnification SEM image of NSHC.

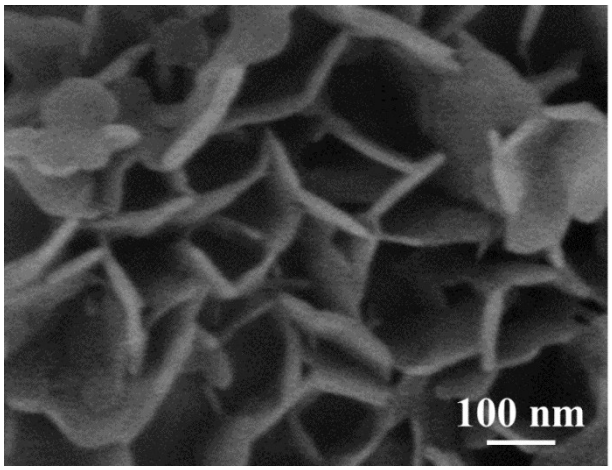

Figure S6. High magnification SEM image of NSHC.

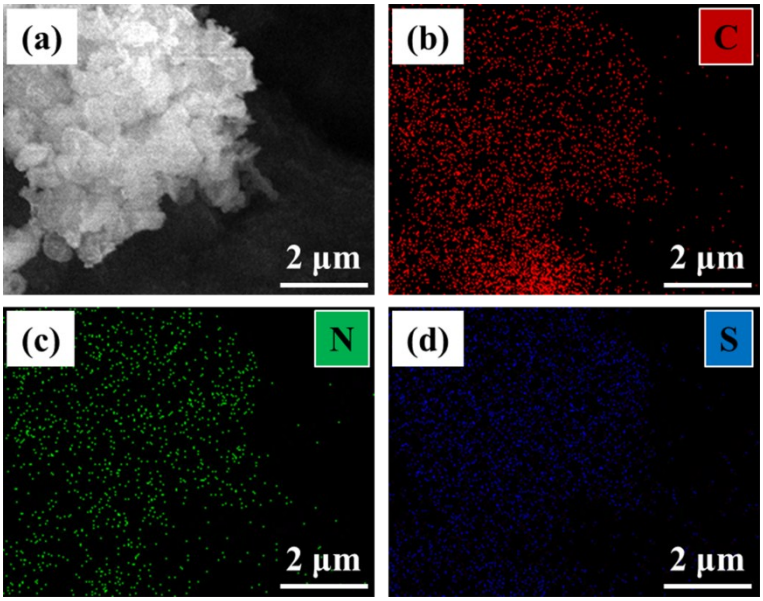

Figure S7. The energy dispersive X-ray spectroscopy (EDS) elemental mapping of NSHC.

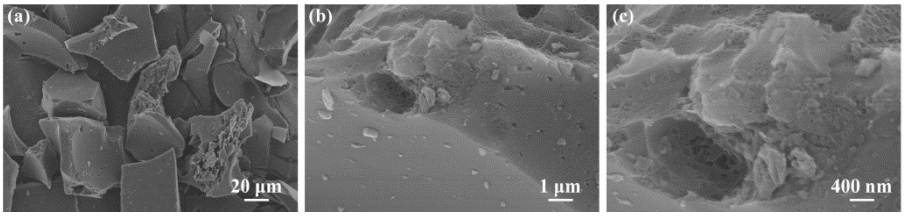

Figure S8. SEM images of NSC.

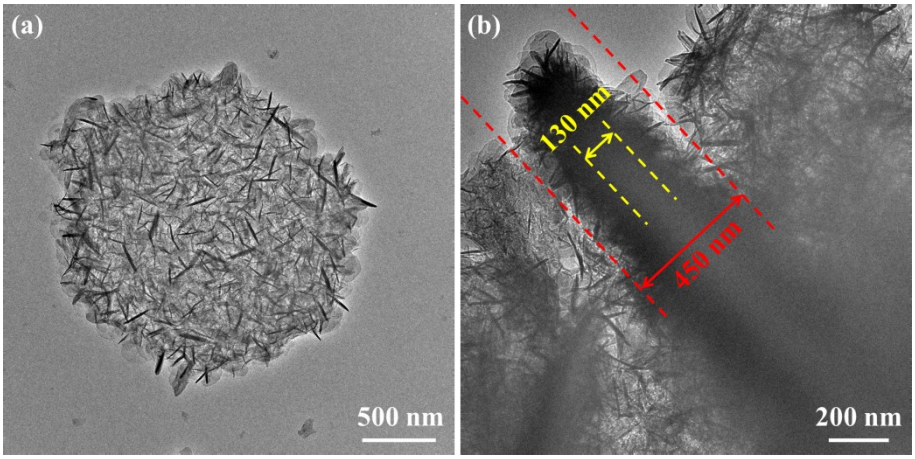

Figure S9. TEM images of NSHC. (a) TEM image observed from top view; (b) TEM image observed from side view.

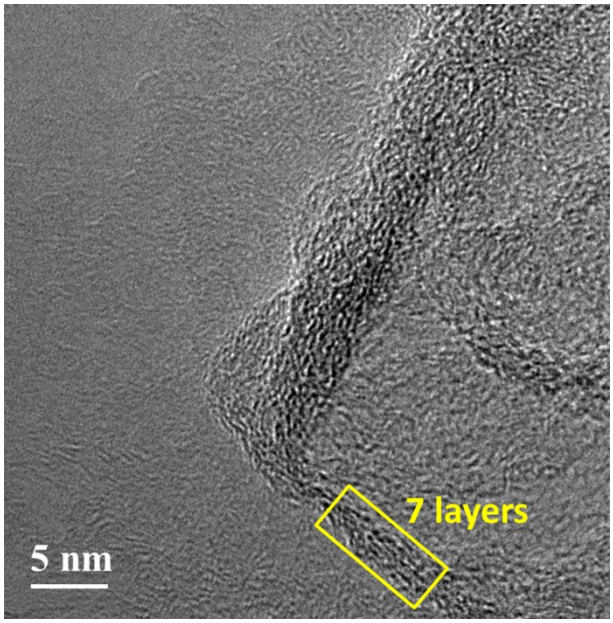

Figure S10. HRTEM image of the ultrathin subunit carbon nanosheets.

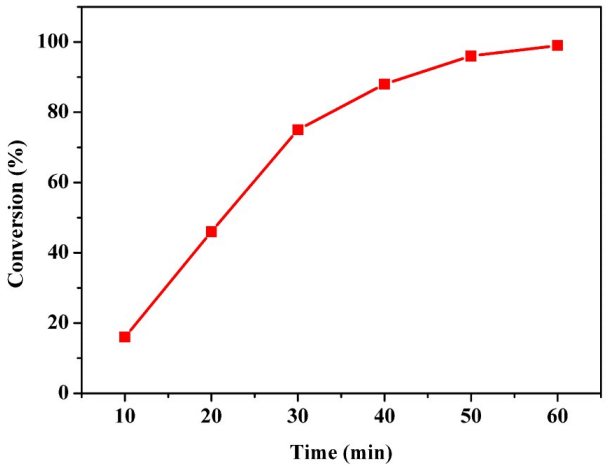

Figure S11. Time dependent conversion over NSHC for nitrobenzene reduction. Reaction conditions: 0.5 g nitrobenzene, 2 mL hydrazine hydrate (85 wt%), 1 mL 1-propanol, 10 mg NSHC, 100 °C.

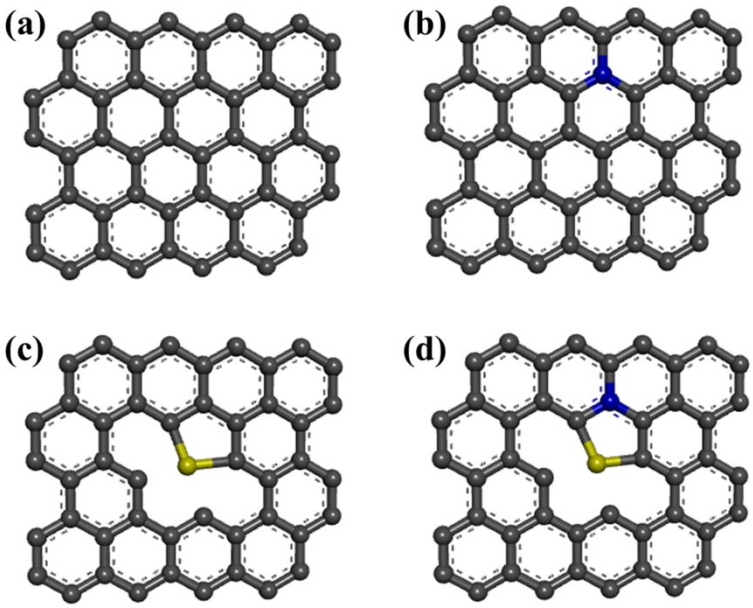

Figure S12. Various graphene models for DFT calculation. (a) Pure graphene; (b) N-doped graphene; (c) S-doped graphene and (d) N,S co-doped graphene.

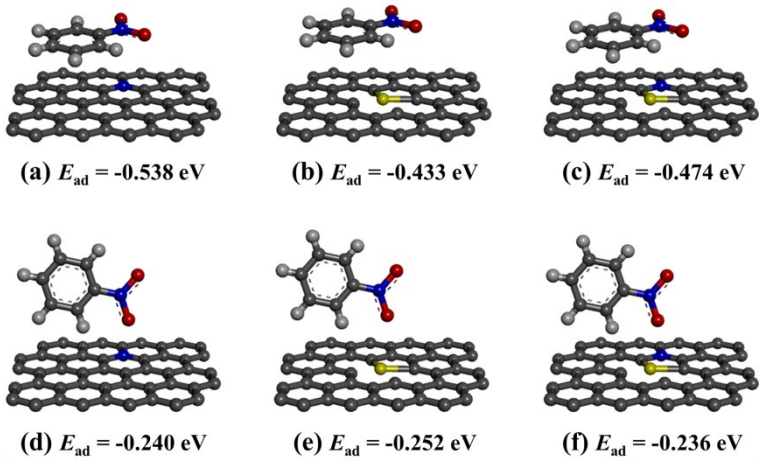

Figure S13. The adsorption energy (E_{ad}) of nitrobenzene on N-doped, S-doped and N,S-codoped graphene models. Both parallel adsorption and vertical adsorption were calculated.

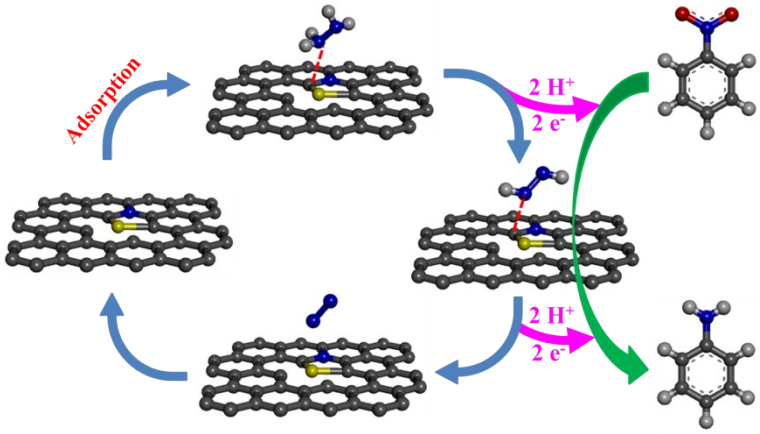

Figure S14. Proposed mechanism for the reduction of nitrobenzene by hydrazine over NSHC catalyst.

Table S1. XPS analytic data of NSHC, NSC, NHC and SHC

sample	C (at%)	O (at%)	N (at%)	S (at%)
NSHC	90.37	5.31	1.93	2.39
NSC	79.24	10.22	8.79	1.75
NHC	89.95	5.44	4.61	--
SHC	87.95	8.76	--	3.29