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Supplementary Information

Removal of Methyl Red from wastewater by NiO@Hyphaene Thebaica seeds-derived porous carbon adsorbent: Kinetics, and isotherm studies

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1 Materials and reagents

Ammonium hydroxide (NH4OH) and nickel nitrate hexahydrate ($Ni(NO_3)_2.6H_2O$) were purchased from Aladdin Chemicals Co. Ltd (Shanghai). Methyl red ($C_{15}H_{15}N_3O_2$) from Sigma-Aldrich. Ethanol absolute (C_2H_6O) from Sinopharm Chemical Reagent Co., Ltd.

2 Characterization and measurements.

A Bruker D8 Advance X-ray diffractometer operating at 40 kV with Cu K radiation (0.154 nm) was used to acquire XRD patterns of the produced materials. Fourier transform infrared (FT-IR) spectra were acquired using an infrared spectrometric analyzer and the KBr pellet technique at a wavenumber in the range of 4000 - 400 cm^{-1}. Transmission electron microscopy (TEM) and images were taken by JEM-2100F field emission microscope (JEOL Ltd., Japan) with an accelerating voltage of 200 kV. A JEOL 2100F microscope was used to take high-resolution transmission electron microscopy (HR-TEM) and selected area electron diffraction

(SAED) patterns. A Micromeritics ASAP 2020 HD88 surface area analyzer used to obtain Nitrogen adsorption-desorption isotherms at -196

Initial MR concentration (mg/L)	R (%)	Qe(mg/g)	R (%)	Qe(mg/g)
	HT-derived C		NiO@HT-derived C composite	

°C. The samples were degassed in vacuum at 393K for 24 h before the measurement. Brunauer-Emmett-Teller (BET) and Barret-Joyner-Halenda (BJH) methods were used to determine specific surface areas, mesoporous, and micropore parameter values, respectively. X-ray photoelectron spectroscopy (XPS) spectra were obtained using 300 W Al K radiation and an ESCALab220i-XL electron spectrometer (VG Scientific).

3 BET surface area

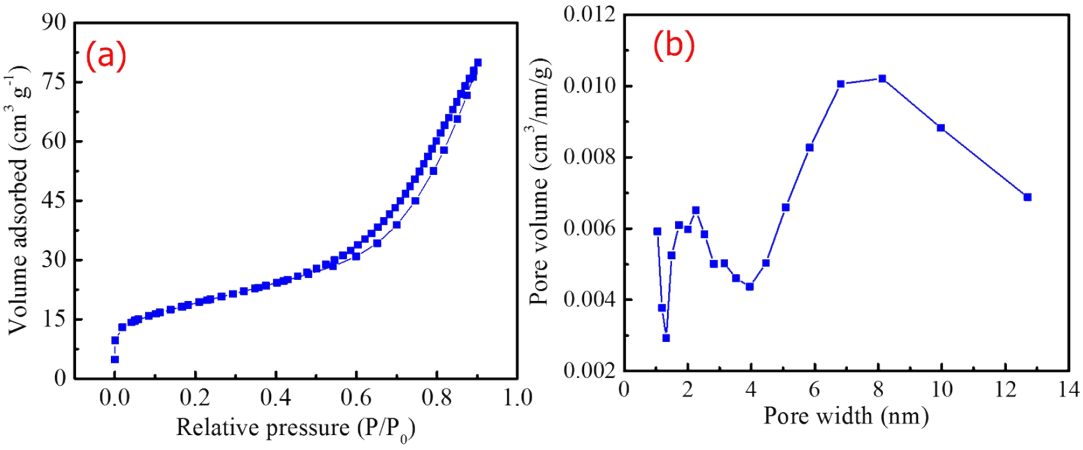

Figure S1: (a) N_2 adsorption-desorption isotherms, and (b) pore size distribution of NiO@HT derived C composite.

10	90.78	6.57	94.69	7.89
30	86.27	22.40	93.63	23.14
50	82.33	36.80	93.33	38.89
70	81.54	47.56	91.54	53.40
90	79.62	58.05	90.73	68.05
100	71.60	56.33	88.59	73.83
120	69.70	66.36	86.36	86.36
150	66.26	82.82	84.26	105.32
170	61.62	83.33	79.24	112.30
200	57.20	83.44	67.70	112.84

Table S1: Effect of initial MR concentration on the removal percentage and adsorption capacity.