

Electronic Supplementary Information

A facile approach for tailoring carbon frameworks from microporous to nonporous for nanocarbons

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Experimental

Preparation: The procedure for preparation of CPPy-NaOH and CPPy-HCl was as follows: 3 ml of pyrrole (Py) was added into hydrochloric acid (HCl) or sodium hydroxide (NaOH) aqueous solutions (60 ml) containing ammonium persulfate (APS) as an oxidant. Then the reaction was stirred continuously for 6 h at ambient temperature for polymerization. The molar ratio of Py: APS: HCl (or NaOH) was 2: 1: 1. Once the Py was added, the reaction solution immediately turned to dark in several seconds with the appearance of precipitate in HCl solution, as opposed to what happened in NaOH solution where the color changed from light red, red brown and finally to the dark accompanied with precipitate for more than ten seconds. After polymerization, the suspension was filtrated off, washed with deionized water and ethanol several times, and then vacuum dried for 24 h. The as-prepared PPy was

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carbonized in a furnace at 800 °C for 3 hours in N₂ flow with a heating rate of 2 °C min⁻¹, thus obtaining the product CPPy-xx, where xx represented the reaction medium of Py, i.e., NaOH or HCl.

Characterization: The microstructure of the samples was investigated by a Hitachi S4800 scanning electron microscope (SEM) and a Micromeritics ASAP 2010 surface area and porosity analyzer. Before N₂ adsorption measurements, the samples were degassed for more than 8 h at 110 °C for PPy or at 250 °C for CPPy. The BET surface area (S_{BET}) was analyzed by Brunauer-Emmett-Teller (BET) theory. NLDFT cumulative surface area for total pores (S_{NLDFT}), micropores (S_{mic}) and external meso-/macropores (S_{ext}) were calculated by nonlocal density functional theory (NLDFT). FT-IR spectra were conducted at room temperature on a Bruker Equinox 55 Fourier transform infrared (FTIR) spectroscopy. The elemental analysis (C, H, N) was executed by using the Elemental Analyzer Vario EL. The X-ray powder diffraction patterns were recorded on a D-MAX 2200 VPC diffractometer using Cu K α radiation (40 kV, 30 mA). X-ray photoelectron spectroscopy (XPS) measurements were carried out on an ESCALAB 250 Spectrometer. Binding energies were calibrated by using containment carbon (C 1s = 284.8 eV). The electrochemical performances of samples were measured in 1 M H₂SO₄ using a sandwich-type two-electrode testing cell. The electrodes were prepared by pressing a mixture of carbon samples, polytetrafluoroethylene and commercial carbon black in the ratio of 8.5:0.5:1 onto a stainless mesh current collector. The electrodes were dried at 110 °C for 8 h. A sandwich-type supercapacitor consisting of two similar sample electrodes was assembled. The electrodes and separators were soaked in 1 M H₂SO₄ electrolyte over 8 h before each assembling. Cyclic voltammetry (CV) measurements with sweep rates of 10~300 mVs⁻¹ for the assembled two-electrode supercapacitors were carried out using an IME6X electrochemical workstation at ambient temperature.

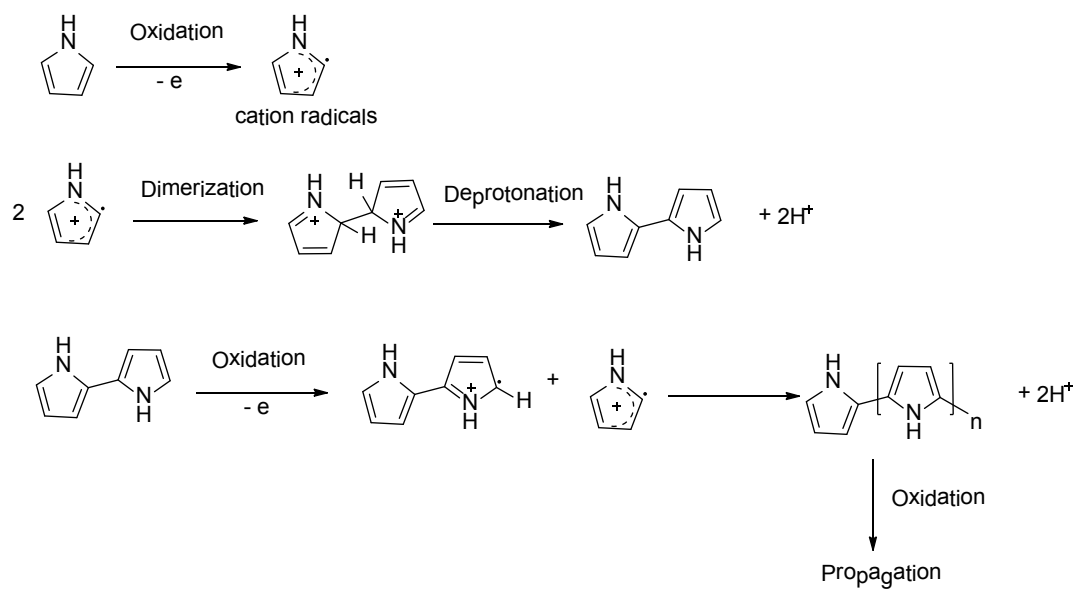


Fig. S1. Possible polymerization mechanism of pyrrole.

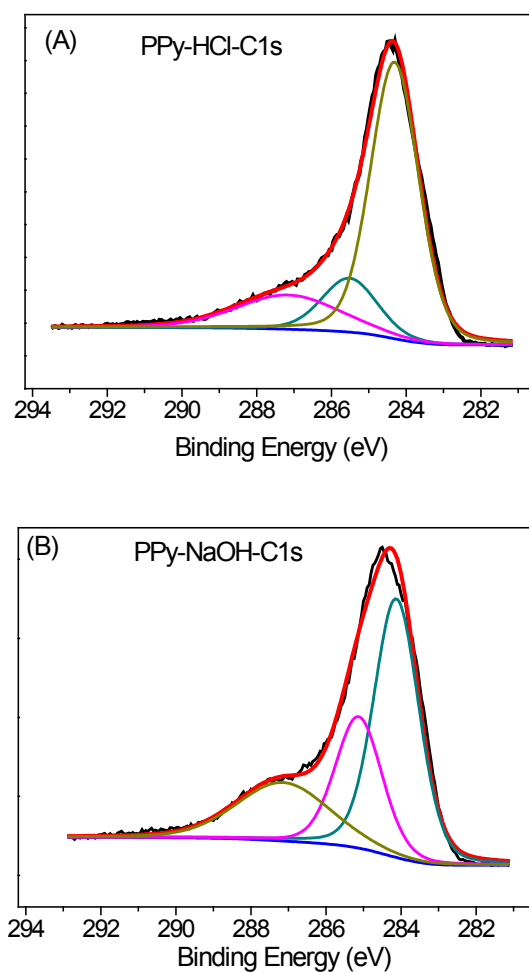


Fig. S2. C1s spectra of (A) PPy-HCl and (B) PPy-NaOH.

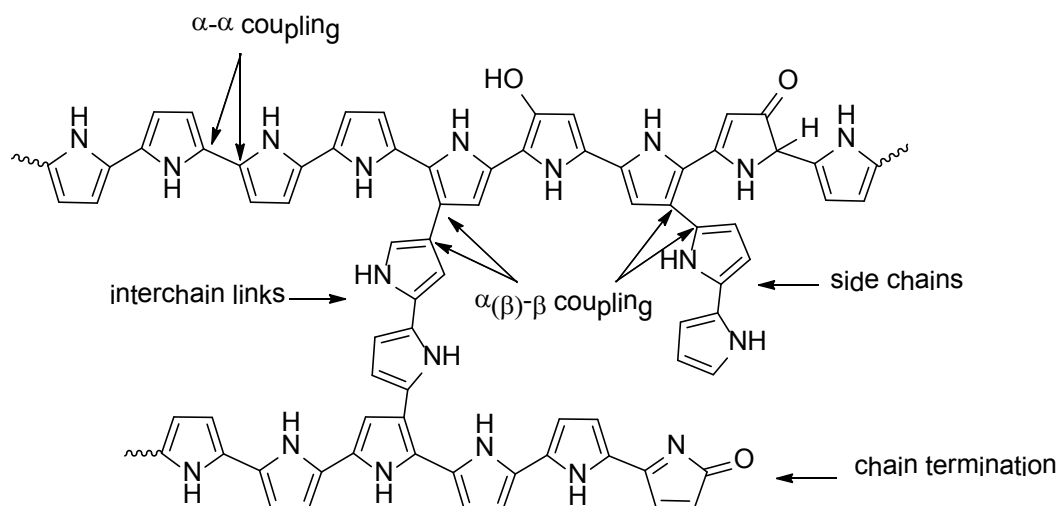


Fig. S3. Possible chemical structures of PPys. For conciseness, the doped state of chains is not given.

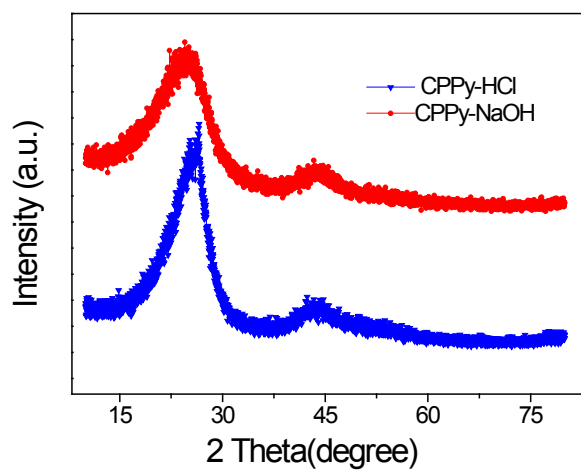


Fig. S4. XRD patterns of CPPy-HCl and CPPy-NaOH.