Supplementary Material

Nitrogen and phosphorus co-doped porous carbon for high-performance supercapacitors

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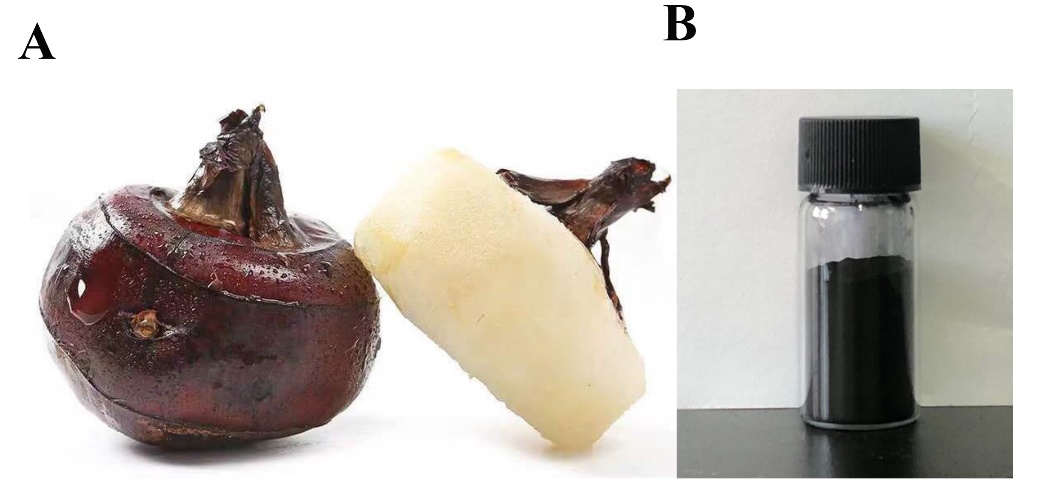
**Electrochemical measurements**

For the three-electrode system, the specific capacitance of GCD was calculated according to the following equation (1):

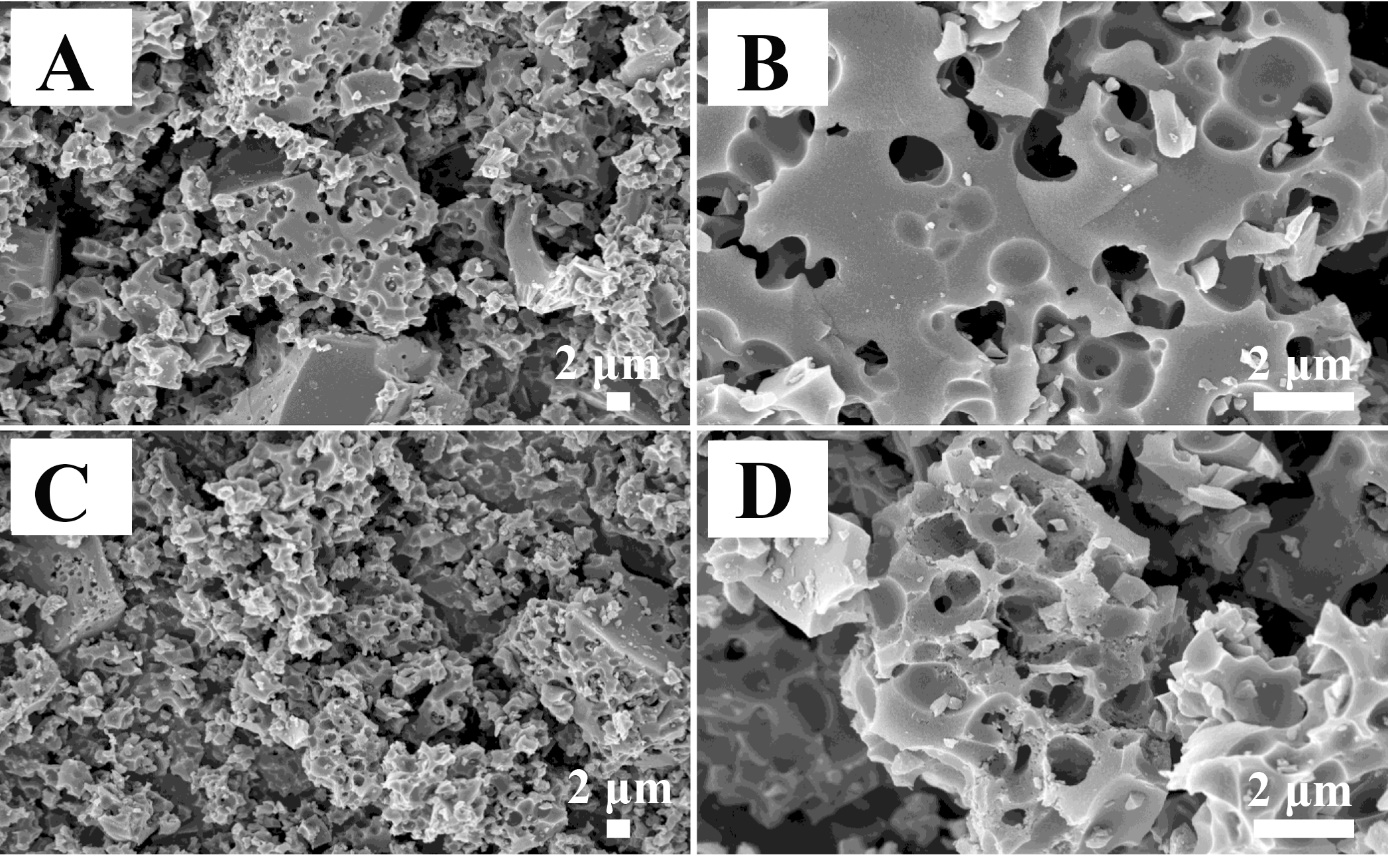
For the two-electrode system, the specific capacitance of GCD was calculated according to the following equation (2):

Where I (A) is the discharge current, m (g) is the mass of the active materials in a single electrode and ΔV (V) is potential window. The energy density (E, Wh/kg) and power density (P, W/kg) was calculated according to the following equations:

Where Cs (F/g) is the specific capacitance of a two electrode device, ΔV (V) is potential window and Δt is the discharge time (s).



**FIGURE. S1** optical images of ED before (A) and after (B) carbonization

**FIGURE. S2** (A, B) SEM images of NPC-1. (C,D) SEM images of NPC-2

**FIGURE. S3** O1s XPS spectra for NPC-3



**FIGURE. S4** (A) CV curves of NPC-3 at different scanning rates; (B) Nyquist plot of NPCs

**Table.S1**. different types of N in PCs according to the XPS results

|  |  |  |  |
| --- | --- | --- | --- |
| Samples | Pyridine-N  (%) | Quaternary-N  (%) | Pyrrolic-N  (%) |
| NPC-1 | 36.5 | 32.1 | 31.3 |
| NPC-2 | 32.9 | 24.7 | 42.4 |
| NPC-3 | 37.2 | 17.4 | 45.4 |

**Table.S2**. Comparison of BET, relative atomic concentrations of the N and P and electrochemical performance of carbon materials derived from biomass precursors

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Biomass precursor | S BET  (m2 g−1) | N content  (at%) | P content  (at%) | Cs  (F g−1) | Measurement  condition | Ref |
| Fish scale | 1134.20 | 5.74 | 32.1 | 332 | 6 M KOH  1 A/g | (Wang et al., 2015) |
| Elaeocarpus tectorius shell | 860.00 | 0 | 8.10 | 201 | 1 M H2SO4  1 A/g | (Nirosha et al., 2020) |
| Silkworm Cocoon | 1247.60 | 3.56 | 1.63 | 317 | 1 M H2SO4  1 A/g | (Wang et al., 2019) |
| Shrimp shell | 725.60 | 3.34 | 1.77 | 206 | 6 M KOH  0.1 A/g | (Qu et al., 2015) |
| Shiitake | 2335.00 | 1.10 | 1.60 | 283 | 6 M KOH  0.5 A/g | (Cao et al., 2016) |
| Silkworm excrement | 2258.00 | 2.15 | 0.26 | 401 | 6 M KOH  0.5 A/g | (Lei et al., 2018) |
| Eleocharis dulcis | 2454.00 | 0.95 | 0.18 | 340 | 6 M KOH  1 A/g | This work |

**References**

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