

Accepted Manuscript

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PII: S0013-4686(16)31370-6
DOI: <http://dx.doi.org/doi:10.1016/j.electacta.2016.06.053>
Reference: EA 27494

To appear in: *Electrochimica Acta*

Received date: 9-3-2016
Revised date: 9-6-2016
Accepted date: 10-6-2016

Please cite this article as: Zhongwei Tian, Min Xiang, Jicheng Zhou, Langqing Hu, Jinjun Cai, Nitrogen and Oxygen-Doped Hierarchical Porous Carbons from Algae Biomass: Direct Carbonization and Excellent Electrochemical Properties, *Electrochimica Acta* <http://dx.doi.org/10.1016/j.electacta.2016.06.053>

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Nitrogen and Oxygen-Doped Hierarchical Porous Carbons from Algae Biomass: Direct Carbonization and Excellent Electrochemical Properties

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Abstract:

Herein, the algae pollutants of *Enteromorpha prolifera* were applied as precursors to obtain nitrogen and oxygen co-doped hierarchical carbons with major pores at around 1.5 and 5.0 nm through direct carbonization at 700 and 900 °C after freeze-drying treatment. Physical properties of porous carbons including morphology, elemental analysis, and pore size distribution were evaluated by transmission electron microscopy, X-ray photoelectron spectroscopy and N₂ sorption. In both cases, surface areas were only close to 450 m² g⁻¹ with 70% areas inherited from mesopores, resulting in high density materials. The carbon derived at 700 °C had the highest capacitance of 234 F g⁻¹ at a current density of 0.5 A g⁻¹ in 6M KOH electrolyte and also had excellent cycling stability with 95% of capacitance after 2000 cycles, owing to the naturally heteroatoms and unique hierarchical nanopores contributed pseudo-capacitance and provided active sites for facilitating electrolyte ions diffusion. In addition, the carbon derived at 900 °C had CO₂ uptake of 6.48 mmol g⁻¹ at 20 bar and 25 °C.

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