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Biomass nitrogen-enriched pyrolysis for nitrogen-doped carbon materials of supercapacitors

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Biomass is a clean, renewable and abundant resource that can be converted to bio-char, bio-oil and fuel gas through various thermochemical processes. Conversion of biomass for high value products is an important development direction for biomass utilization, which has attracted more attention. In this study, a new method of biomass pyrolysis with exogenous nitrogen introduced was proposed. The influence of NH_3 on the property of bamboo pyrolysis process and products characteristics was investigated with variant approaches (e.g. elemental analysis, automatic adsorption equipment, X-ray photoelectron spectroscopy and CHI760 electrochemical workstation) and as well as the influence of KOH (as activator). The results showed that, the specific surface area, the content of nitrogen and nitrogen-containing functional groups of bio-char increased significantly with NH_3 introduced in. On the other hand, with the addition of KOH, the yield of bio-char increased obviously and it increased gradually with increasing KOH amount, and the specific surface area increased dramatically to 1873.17 m2 g-1. The content of nitrogen in bio-char increased greatly with KOH introduced in, especially the content of pyridinic-N and pyrrolic/pyridone-N, while it decreased slightly with increasing KOH amount, but nitrogen content was still relative high (9.1-10.4 wt.%). The formation mechanism of nitrogen-containing functional groups was proposed. Besides, electrochemical analysis showed that the specific capacitance of bio-char electrodes increased with increasing KOH content, and the largest specific capacitance could reach to 187 F g^{-1} at 1 A g^{-1} with good cycling stability. Therefore, it could be concluded that biomass nitrogen-enriched pyrolysis was a promising method for more efficient utilization of biomass resources.

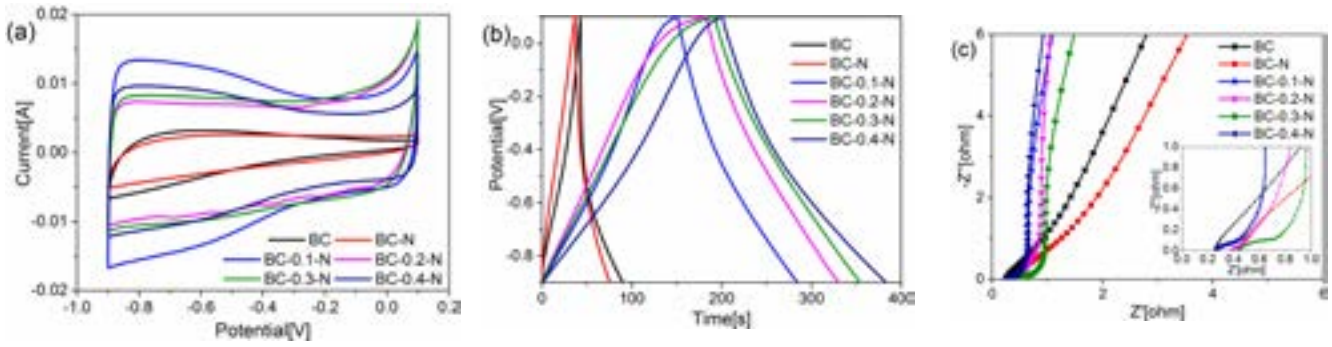

Figure 1: Electrochemical performance of bio-chars: (a) Cyclic voltammetry curves at 10 mV s-1; (b) Galvanostatic charge/discharge curves at 1 A g-1; (c) Nyquist plots (the inset shows the expanded high frequency region of the plot).

Biography

Haiping Yang has been the Research Fellow of the State Key Laboratory of Coal Combustion in Huazhong University of Science and Technology since 2005. She received her PhD degree from Huazhong University of Science and Technology in 2005. Her major research areas are: biomass pyrolysis for gas, bio-oil and char multigeneration, especially on the fundamental study of biomass pyrolysis; Biomass gasification for H2 enriched synthesis gas; Biomass catalytic fast pyrolysis for liquid fuel; biomass pyrolysis for high-value products. She has published more than 60 papers. She was an excellent youth winner of Natural Science Foundation Project. Published articles from *Fuel* (2007, 86: 1781-1788) and *Energy & Fuels* (2006, 20(1):388-393) have been cited in ESI database from 2010. So far the number of citation in web of science for the two papers is 1367 and 313, respectively. The paper in *Fuel* journal is also one of the most downloaded and cited one.

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