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Biomass-derived nitrogen-doped porous carbon with superior capacitive performance and high CO_2 capture capacity

Huanming Wei[1], Jing Chen[1], Ning Fu, Haijun Chen, Hualin Lin* and Sheng Han*

School of Chemical and Environmental Engineering, Shanghai Institute of Technology, Haiquan Road 100, 201418, Shanghai, P. R. China.

([1]These two authors contributed equally to this work. *Corresponding author. E-mail address: lhl6534@163.com (H.-L.L.) Tel.: +86 17701878558; fax: +86 21 60873228; E-mail address: hansheng654321@sina.com (S. Han.) Tel.: +86 21 60873560; fax: +86 21 60873560)

Abstract

Nitrogen-doped porous carbon is synthesised through a low-cost approach that utilise water chestnut as a carbon source and melamine as a nitrogen source through potassium hydroxide (KOH) activation for 2 h at 600 °C–900 °C. The obtained samples exhibit predominant characteristics with highly developed micropores, an ultralarge specific surface area (3401 m^2 g^{-1}) and a high nitrogen content (4.89 at.%). These characteristics endow nitrogen-doped porous carbon with a high specific capacity of 346 F g^{-1} and a high energy density of 22.4 W h kg^{-1} at 0.5 A g^{-1} in 6 mol dm^{-3} KOH. It also exhibits an excellent cycling stability with a retention of nearly 97.6% capacity after 5000 cycles at 1 A g^{-1}. In addition, the unique pore structure and high nitrogen content of porous carbon provide an important contribution to CO_2 adsorption capacity, which can reach up to 6.0 mmol g^{-1} (at 0 °C and 1 bar) and 4.7 mmol g^{-1} (at 25 °C and 1 bar), and to high CO_2/N_2 selectivity. Results show that the synthesised porous carbon exhibit considerable potential in electrochemical energy