Hydrochar derived high-mesopore area carbon as a cathode for Li-ion hybrid electrochemical capacitors

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Mesoporous carbons with high surface area were synthesized by using hydrothermal treatment of biomass (coconut shell) in the presence of $ZnCl_2$ as the activating agent. Mesopore development is shown to be promoted by conditions that favour increased diffusion of $ZnCl_2$ into the biomass and leads to effective dehydration compared to conventionally employed conditions. Upon physicochemical activation, the hydrochar yielded mesoporous carbon with enhancement of mesopore area by up to 67%.

The mesoporous carbons were used as a cathode material in a non-aqueous medium for the fabrication of the Li-ion Hybrid Electrochemical Capacitors **(**Li-HEC) with commercially available $Li_4Ti_5O_{12}$ serving as the anode. Increase in mesoporosity by the use of hydrothermal treatment was manifested as a significant energy density of ~ 69 Wh kg^{-1} relative to that obtained from commercial activated carbons (36 Wh kg^{-1}) and excellent cycleability ~ 2000 cycles of the Li-HEC. The study underscores the utility of simple pre-treatment protocols that increase the efficiency and effectiveness of the adsorbent matrix for development of high energy density Li-HEC.