NAME OF THE THEME: Renewable Energy Sources

Development of coconut charcoal based activated carbon with tailored properties for high performance super-capacitor application

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ABSTRACT: Activated carbon finds many industrial applications in energy storage (super capacitors, batteries), water purification, energy conversions (fuel cells, solar cells), sensors, environmental protection (regulation of SO_x and NO_x) etc. Due to its high specific surface area and tunable porosity activated carbon is becoming the most demanding electrode material for commercial super capacitor fabrication. We aim for the cost effective production of activated carbon material with tunable properties for super capacitor application and finally match the properties of commercial YP-50 based super capacitor. Here, we report a scalable synthesis method of activated carbon from coconut char (AC-ARCI) which has a potential to go directly to industrial scale. Coconut char is being treated by potassium hydroxide (KOH) in presence of N_2 gas. It was then annealed in the range of 700 to 900^0C in Ar and H_2 atmosphere to remove the traces of metallic potassium. A collective study to optimize the treatment process for better yield was done. And, the yield is found to be around 45 – 50 wt %. The microstructural, elemental and crystal structural characterization was done by scanning electron microscopy (SEM), energy dispersive x-ray spectroscopy (EDX), and x-ray diffraction (XRD). The average particle size (~ 5.5 μm) has been optimized by optimizing the milling parameters. The BET specific surface area and micro pore volume was found to be 1374 m^2g^{-1} and 0.65 ccg^{-1} respectively which is comparable with the commercially available activated carbon YP-50. A detail comparative electrochemical study of AC-ARCI and commercial YP-50 has been done to see the performance as super capacitor. The specific capacitance of AC-ARCI obtained by galvanostatic charge-discharge was found to be 148.74 F/g at a current density of 0.25A/g with energy and power densities of 20.65 Wh/kg and 254.40 W/kg respectively. These values are close to those obtained by using commercial YP-50. In summary, an efficient and cost-effective technique is developed to prepare activated carbon with high specific surface area and specific capacitance comparable to commercial YP-50.

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