Facile fabrication of thin metal oxide films on porous carbon for high density charge storage

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ABSTRACT:

In an effort to minimize the usage of non-renewable materials and to enhance the functionality of the renewable materials, we have developed thin metal oxide coated porous carbon derived from a highly abundant non-edible bio resource, i.e., palm kernel shell, using a one-step activation-coating procedure and demonstrated their superiority as a supercapacitive energy storage electrode. In a typical experiment, an optimized composition contained ~10 wt% of Mn_2O_3 on activated carbon (AC); a supercapacitor electrode fabricated using this electrode showed higher rate capability and more than twice specific capacitance than pure carbon electrode and could be cycled over 5000 cycles without any appreciable capacity loss in 1 M Na_2SO_4 electrolyte. A symmetric supercapacitor prototype developed using the optimum electrode showed nearly four times higher energy density than the pure carbon owing to the enhancements in voltage window and capacitance. A lithium ion capacitor fabricated in half-cell configuration using 1 M $LiPF_6$ electrolyte showed larger voltage window, superior capacitance and rate capability in the ~10 wt% Mn_2O_3 @AC than the pure analogue. These results demonstrate that the current protocol allows fabrication of superior charge storing electrodes using renewable materials functionalized by minimum quantity of earthborn materials.

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