Development of new carbon-based electrode material from oil palm wastes-derived reduced graphene oxide and its capacitive performance evaluation

ABSTRACT

This paper is an expansion of our previous work on the synthesis of graphene oxides and reduced graphene oxides from different kinds of oil palm waste-based feedstocks, namely, OPL (oil palm leaf), PKS (palm kernel shell), and EFB (empty fruit bunch). Here, the electrochemical measurements of the resulting reduced graphene oxides derived via mild-temperature annealing reduction of the graphene oxides were accomplished using cyclic voltammetry and galvanostatic charge/discharge processes. The findings put forward their promising features for supercapacitor applications. For instance, the reduced graphene oxide derived using EFB precursor (rGOEFB) which has a BET surface area of 117 m2 g-1 exhibits a specific capacitance of 688 F g−1 at an applied current density of 0.8 A g-1. This is higher than that observed for reduced graphene oxides derived from oil palm leaf (rGOOPL), palm kernel shell (rGOPKS), and the commercially acquired graphite (rGOCG), which possessed specific capacitance values of 632, 424, and 220 F g−1, respectively. It can be deduced that the specific capacitance of the reduced graphene oxide samples increases in the following order: (rGOCG) < (rGOPKS) < (rGOOPL) < (rGOEFB). In summary, these new classes of carbon-based nanomaterials could be applied as efficient electrode materials for supercapacitor application with potential good performance. With this novel green and sustainable approach, various carbon-based nanomaterials can be fabricated for a broad range of multifunctional applications.