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Single-route synthesis of binary metal oxide loaded coconut shell and watermelon rind biochar: Characterizations and cyclic voltammetry analysis

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Abstract

Generally, the type of biomass precursors is one of the key factors affecting the properties of synthesized biochar. This novel study therefore examined the single-route preparation of coconut shell and watermelon rind biochar with the combination of two types of binary metal oxide, iron nickel oxide (Fe_2NiO_4), and cobalt iron oxide ($CoFe_2O_4$) by employing a novel vacuum condition in an electric muffle furnace. The samples were characterized by several methods such as Fourier transform infrared (FTIR), field emission scanning electron microscope (FESEM), thermogravimetric analysis (TGA), X-ray diffraction (XRD), and Brunauer–Emmett–Teller (BET) Surface Area. The optimum pyrolysis temperature for producing a high surface area of

322.142 m^2/g and 441.021 m^2/g for coconut shell biochar and watermelon rind biochar, respectively, was recorded at 600 °C. FTIR analysis revealed lesser adsorption bands found in FTIR spectrum of the samples with higher pyrolysis temperature (500–700 °C). In addition, FESEM results also revealed the surface changes of the samples with the impregnation of $CoFe_2O_4^4$ and Fe_2NiO_4. Furthermore, the value added application of biochar in electrochemical energy storage has been explored in the present work. In typical three-electrode configuration, WR-BMO 600 exhibits about 152.09 Fg^{-1} with energy density about 19.01 Wh kg^{-1}.

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