Green and High-Performance Supercapacitor Prepared by NiO Embedded Carbon and Nanocellulose from Corn Wastes

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The major advance in energy storage today has mainly been focusing on lithium-based batteries due to their good overall performances in storage capacity. However, for applications requiring high power and over ten of thousands of cycles, another type of energy storage, supercapacitor, with ultrafast charge-discharge rate and long cycle life is of advantage. Currently, activated carbon is normaly used to make electrodes for supercapacitor. Since Thailand has high amounts of agricultural wastes, this project aimed to develop bio-derived electrode that may provide compatible or even better capacitance than the current product in the market. The uses of corn husks and corn cobs as the raw materials to make supercapacitor electrode were focused. Corn husks was used to synthesize nanocellulose and corn cobs was pyrolyzed at 500 °C in the presence of KOH to obtain activated carbon. To enhance the electrode capacity, the activated carbon was doped with nitrgen by pyrolyzing with NH_4Cl. Then, the N-activated carbon (N-AC) was treated with $Ni(NO_3)_2$, where nanoparticles of nickel oxide (NiO) was embedded in N-AC. Micro- and nano-structures of the nanocellulose and carbon were characterized using SEM and TEM. Physical and chemical composition of the synthesized materials were also investigated using XRD, Raman, and IR spectrometry. The NiO nanoparticles embedded N-AC and nanocellulose with various mass ratios were then made into supercapacitor electrodes and button cells to test capacitive performances.