Phosphorous/Nitrogen Co-Doped Carbon Derived from Soybean as High Performance Electrode Material for Supercapacitor

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First time, soybean is investigated for supercapacitor application, because of its importance towards Arkansas's economy. In this project, phosphorous and nitrogen co-doped carbon (PNDC) was derived from soybean using an inexpensive, eco-friendly and quick single step microwave-assisted process to prepare electrode material for supercapacitor. Ammonium Polyphosphate is used as a doping material, which served as the main source of Phosphorus and Nitrogen, as well as the microwave absorber. Concentrations of the doping elements, Phosphorus and Nitrogen, were altered by changing the mole ratio of Ammonium Polyphosphate to soybean in the reaction mixture. Physical and electrochemical characterizations were performed to investigate the supercapacitor performance of PNDC materials. Physical characterization was performed using a Brunauer Emmett Teller (BET), Scanning Electron Microscopy (SEM), and X-ray Photoelectron Spectroscopy (XPS), while electrochemical characterization was performed using Cyclic Voltammetry in both acidic and basic media. The elemental composition, porosity, and surface area was analyzed to investigate the most important parameters in achieving high supercapacitance. For comparison, the experiment was also conducted on PNDCs derived from molasses. The highest specific capacitance of 153 F/g was achieved on soybean-based PNDC as compared to the highest specific capacitance of 160 F/g on molasses-based PNDC. Thus, soybean-based PNDC exhibit great potential to develop inexpensive (<$1) electrode material for energy storage. To improve the performance of soybean-based PNDC, different doping agents at variable concentrations will be used to tune and optimize the micro and mesopore size of the materials

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