Defatted Soy as a High-Performance Energy Storage Material for Supercapacitor

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Lithium-Ion Batteries used in electric vehicles today are expensive, toxic to the environment and take a long time to recharge. Supercapacitor is considered as an alternate, inexpensive, and ecofriendly energy storage solution with quick charging characteristics. Several renewable soy-based materials (soymeal, and defatted form of soymeal, soy flour and soy protein) are selected as a carbon source to prepare inexpensive, green carbon-based materials for supercapacitor application. Soybean is the largest crop of Arkansas and vital for its economy and it contains heteroatoms. The soy-based carbonized samples both undoped and doped were prepared using a low cost, green and facile microwave assisted process. The capacitance of regular and defatted soy meal samples was compared to explore the role of fats/oils in the material. In addition, role of heteroatoms is also examined. Furthermore, the samples were characterized physically via XPS, and SEM analysis to investigate the critical parameters for supercapacitor performance of the materials. Cyclic voltammetry results support the hypothesis that defatting the material improves the conductivity and capacitance of soy materials. Doped carbon derived from defatted soy protein exhibited the highest specific capacitance in acidic media due to mesoporous structure, and high surface area. Unexpectedly, the undoped defatted soy flour showed the second highest capacitance in basic media due to high contents of Potassium, Nitrogen and Phosphorus which is naturally present in the material. Doped carbon material derived from Soybean exhibits great potential to develop inexpensive (<$1) electrode material for energy storage which will consequently affect the economy of Arkansas.