Nitrogen-enriched activated carbon from shrimp shells as the electrodes for supercapacitors

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Abstract: Supercapacitors (also known as electrochemical capacitors) have transpired as attractive power sources with high energy densities and long cycling life substituting batteries in some energy storage fields. Porous carbon materials amalgamated with heteroatoms have been extensively researched as promising electrode materials for supercapacitors. The activated carbon is produced from chitin in shrimp shells which naturally contain nitrogen. The raw materials are mixed with lignin to increase carbon content. Shrimp shells are used to avoid the need to chemically obtain nitrogen from the doping process. Nitrogen enriched activated carbon is of interest as nitrogen can increase the specific surface area of the original activated carbon by enhancing its surface functionalities. We have found that increasing the nitrogen content by 1.77 weight percent could enhance specific surface area to 2350 squared meters per gram. However, high nitrogen content could decrease the specific surface area as more nitrogen can collapse the framework of carbon. The presence of N species in the carbon framework could contribute to pseudocapacitance of which a charge is stored by means of surface-redox reactions. Therefore, the obtained nitrogen enriched activated carbon could potentially be used as electrode materials for the development of high-performance supercapacitors.

Keywords: Nitrogen-enriched activated carbon; Shrimp shell; Lignin; Supercapacitors