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SOLVENT-FREE MESOPOROUS CARBON FROM TANNIN BIOMASS AS A SUPPORT FOR Li-S BATTERIES

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As new demands for sustainable, high-performance energy storage systems emerge, devices such as lithium-sulfur (Li-S) batteries are seen as a good option due to their high theoretical capacity (1675 mAh g^{-1}) and relative low cost[1,2]. However, this type of device still presents challenges, such as the leaching of polysulfides (known as *shuttle effect*) and the fact that the species undergo volume changes during the reaction, requiring a conductive support capable of containing these variations. One of the strategies adopted is the use of a mesoporous carbon support, which works not only as a conductor, but also to retain polysulfides in the pores. Therefore, the objective of this work is to evaluate the electrochemical performance of a mesoporous carbon derived from tannin biomass incorporated with sulfur (S) synthesized in a sealed vessel in a heating mantle. The mesoporous carbon was obtained via *solvent-free* synthesis which involves milling tannin (carbon source), Pluronic F127 (surfactant) and terephthalaldehyde (crosslinking agent), followed by heating to 900 °C (rate of 10 °C min^{-1}) thus obtaining CM[2]. The incorporation of S was done in a 1:1 carbon:sulfur (C:S) ratio, where the sulfur was previously ground as well as the C:S mixture. The material was then heated at 155 °C (rate of 2 °C min^{-1}) for 24 h to incorporate the sulfur via *melt diffusion*, obtaining CMS. CM and CMS were characterized by TGA, CHNS, XRD, SEM, MET and nitrogen physisorption. The electrochemical characterizations were accomplished by cyclic voltammetry (CV) and galvanostatic charge-discharge cycling. The CM carbon obtained has a BET specific surface area of 668 m^2 g^{-1} and pore distribution centered at 5,6 nm, values that are in accordance with those reported in the literature[2]. The CMS material presents a BET specific area of 15 m^2 g^{-1} and pore distribution also centered at 5,6 nm, presenting a drastic loss of area (reduction of 98%) and pore volume for the CMS incorporated sample, which is attributed to sulfur diffused into the pores of the material. In the XRD spectra it is possible to observe the carbon peaks for both samples, and for the CMS sample, which contains 44% sulfur, the S peaks are not observed. This reinforces the idea that sulfur is diffused in the pores of the material. The thermal analysis under a nitrogen atmosphere for CMS presents two sulfur loss events, the first at 290 °C (loss of 30% of the most superficially incorporated S) and the second at 414 °C (loss of 14% of S incorporated in the micropores), totaling 44% of S, which agrees with the elementary analysis 47% of sulfur[1]. Considering CV curve, the assembled cell exhibited the typical profile of a Li-S battery[2]. The galvanostatic charge-discharge data showed the battery achieved a specific capacity of 775 mAh g^{-1} at C/10 in agreement with other systems presented in the literature[2]. Observing the set of characterizations of the material and its electrochemical performance, it is possible to conclude that the carbon material can support sulfur and retain polysulfides, proving to be an effective and interesting strategy in the development of sustainable Li-S batteries.

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