Textural and electrochemical characterization of carbon aerogel from cellulose

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Cellulose is the most abundant biomass material in nature, its hierarchical and multi-level organization allows to get different kinds of cellulose nanoparticles. The physicochemical properties of nanocellulose have enabled their use in a wide variety of hydrophilic or hydrophobic composite as carbon aerogels (CAs) [1]. CAs are a unique class of high surface area materials, their electrical conductivity, environmental compatibility, and chemical inertness make them very promising materials for applications, such as energy storage [2]. This work characterizes the capacitive behavior of a carbon aerogel obtained from coffee husk cellulose. In order to evaluate the advantages of its monolithic structure, two different working electrodes were built, the first one by dropcasting a slurry of CA over ITO glass and the second one is a monolithic electrode. The cellulose cryogel was obtained by means of sol–gel method followed by freeze drying. Lastly, to get a carbon aerogel, physic activation with CO_2 was performed. In order to characterize the carbon aerogel textural properties, nitrogen adsorption-desorption isotherms were recorded. The specific surface area was determined by using the Brunnauer-Emmet-Teller (BET) method and pore size distribution (PSD) by using the nonlocal density functional theory (NLDFT) method. The electrochemical properties of carbon aerogels were also investigated by means of cyclic voltammetry (CV), galvanostatic charge/discharge (GCD) and electrochemical impedance spectroscopy (EIS). Some properties, such as: capacitance (Cs, F g^{-1}), energy density (E, Wh kg^{-1}), power density (P, W kg^{-1}) and equivalent series resistance (ESR, ohms) are calculated from electrochemical measured data.

[1] G. Siqueira, J. Bras, and A. Dufresne, "Cellulosic bionanocomposites: a review of preparation, properties and applications," *Polymers,* vol. 2, pp. 728-765, 2010.

[2] S. Chandrasekaran, P. G. Campbell, T. F. Baumann, and M. A. Worsley, "Carbon aerogel evolution: Allotrope, graphene-inspired, and 3D-printed aerogels," *Journal of Materials Research,* vol. 32, pp. 4166-4185, 2017.