Hybrid Materials in Asymmetric Supercapacitors

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In the present work electrochemical studies of a series of polyoxotungstate – active carbon hybrid materials are described. The electrochemical behavior of two polyoxometalate molecules, phosphotungstic acid ($H_3PW_{12}O_{40}$) and silicotungstic acid ($H_4SiW_{12}O_{40}$) have been studied to be used as negative electrode in asymmetric Supercapacitors (a-SCs). The strong chemisorption between polyoxometalates and carbon materials makes it possible to construct stable hybrid carbon structures. [1, 2]

The methodology followed to prepare hybrid materials was as described in ref. [3], where 1g of activated carbon (Super-DLC-30 kindly supplied by Norit Chemicals®) is added to 25 mL of a 10 mM aqueous solution of each of the heteropolyacids ($H_3PW_{12}O_{40}$ and $H_3SiW_{12}O_{40}$). The mixture is stirred for 24h at room temperature. Then, the suspensions is filtered, washed with deionized water, and dried at 100°C overnight. The amount of PW_{12} and SiW_{12} adsorbed is determinated by weight difference.

Cyclic voltammetry and galvanostatic charge-discharge tests were employed to do the electrochemical characterization of the hybrid materials. Two- and three-electrodes configurations, where platinum wire and Ag/AgCl were used as counter and reference electrode, respectively. A 1 M H_2SO_4 solution was used as electrolyte.

The cyclic voltammograms obtained in a three electrode configuration for a commercial activated carbon, AC, and for the AC/ SiW_{12} hybrid material are shown in Figure 1. Both materials show different stability ranges are stable in a different range of potential. The hybrid material showed a remarkable increased stability towards negative potentials (over potential for hydrogen generation). In an asymmetric configuration where AC is the positive electrode and AC/ PW_{12} is the negative one, the total cell voltage could be extended up to 1.6 V, thus increasing the energy density of the devices substantially.

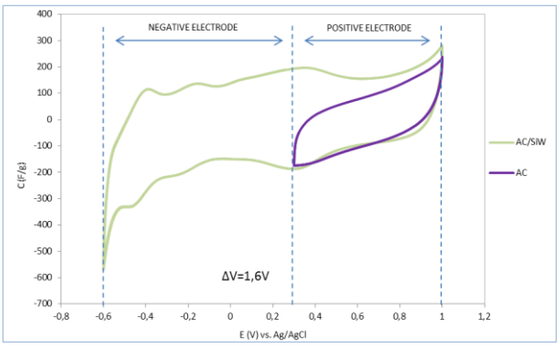

Figure 1.- Cyclic voltammograms obtained in a three -electrode configuration for an activated carbon (AC) and its corresponding hybrid material (AC/SiW12).

References

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