Activated Carbon Fiber obtained from textile PAN fiber to electrodes for supercapacitor

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INTRODUCTION

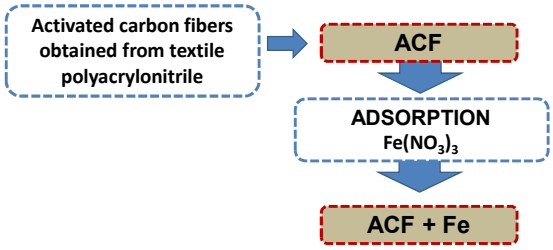
Supercapacitors are devices for electrical energy storage, it consist in two electrodes separated by an ion-permeable membrane, and an electrolyte that make the ionic connecting both electrodes.

Current challenges in supercapacitors development are focuses on maximizing the energy density. That can be achieved by developing electrodes materials with high specific electrical capacitance and high electrical conductivity. Furthermore, it is expected that the electrode material present a simple procedure for obtaining, low cost and environmentally friendly.

Carbon fibers are interesting materials for use as supercapacitor electrode. On the other hand, in acidic electrolytes, transition metals deposited on surface of carbon materials can improve the electrical capacitance through its participation in redox reversible reactions .

In this work, activated carbon fiber obtained from textile polyacrylonitrile (ACF) and ACF/Fe particles composite (ACF+Fe) were studied as supercapacitor electrodes .

SAMPLES PREPARATION

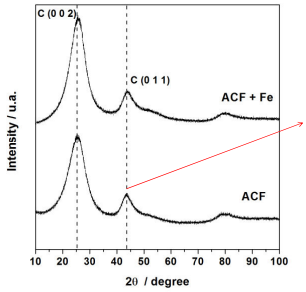


RESULTS AND DISCUSSION

Textural analysis

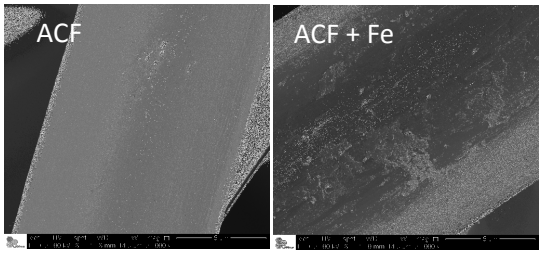
Sample	V_T ($cm^3 g^{-1}$)	S_{BET} ($m^2 g^{-1}$)	dp (nm)
ACF	0.60	1260	3.2
ACF + Fe	0.51	1090	3.0

XRD

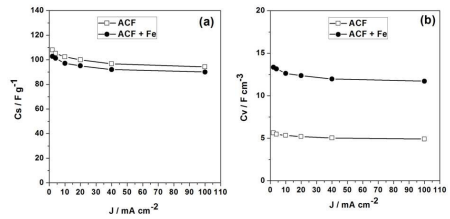


This peak at 44 ° indicates a more organized aromatic carbon structure with marked sp^2 bonding character.

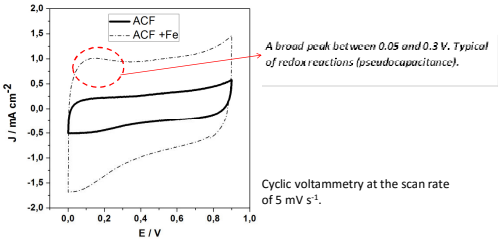
SEM



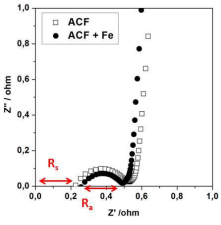
Electrochemical characterization in a 2 mol L^{-1} H_2SO_4 electrolyte using a Two-electrode Swagelok®-type cells.



(a) Specific capacitance vs. current density (b) Volumetric capacitance vs. current density.

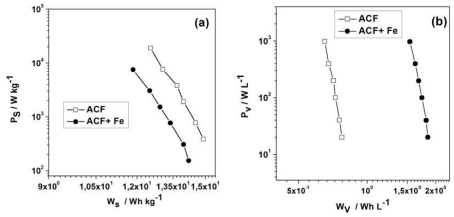


Cyclic voltammetry at the scan rate of 5 mV s^{-1}.



Sample	R_S (Ω cm^2)	R_s (Ω cm^2)	R_T (Ω cm^2)
ACF + Fe	0.26	0.23	0.49
ACF	0.22	0.29	0.51

Nyquist diagram for ACF and ACF + Fe. R_s is the arc resistance and R_s is the electrolyte bulk resistance.



(a) Gravimetric power density vs. gravimetric energy density and (b) Volumetric power density vs. volumetric energy density.

Conclusions

- ❑ The activated carbon fibers have a high specific surface area and higher structural order of the aromatic carbon structure.
- ❑ The tested electrochemical cell using the fibers as electrodes present lower total resistance (R_T). Very good for supercapacitor application.
- ❑ ACF shows the highest specific electrical capacitance and energy density.
- ❑ ACF+Fe shows the highest volumetric capacitance and energy density.
- ❑ Fe particles in the ACF+Fe participate in pseudocapacitive reactions.

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