

Performance study of a thin cation exchange membrane for water based supercapacitor applications

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Performance study of a thin cation exchange membrane for water based supercapacitor applications

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Background

A novel method to modify **activated carbon electrodes** through addition of **selective ion exchange polymers (IEM)** is presented. Nowadays the preferred method to self-polarize an electrode in an EDLC is to place a stand-alone membrane in proximity of the electrode itself [1, 2]. This technique produces some drawbacks brought about the dimension of the device: an increase of the internal series resistance and reduction of overall capacitance. With the proposed methods, it is possible to use the IEM **directly in the production** of the slurry (instead of traditional binders) or in a **conformal contact** with the electrode.

Electrode fabrication



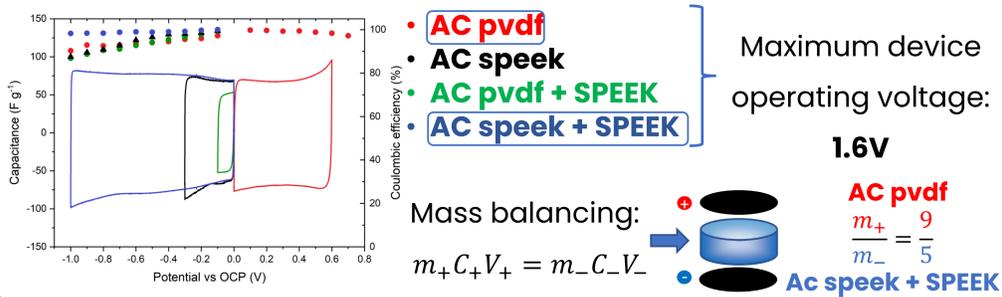
Negative electrode:

- SPEEK binder
- Melted SPEEK casted over AC, dried under vacuum

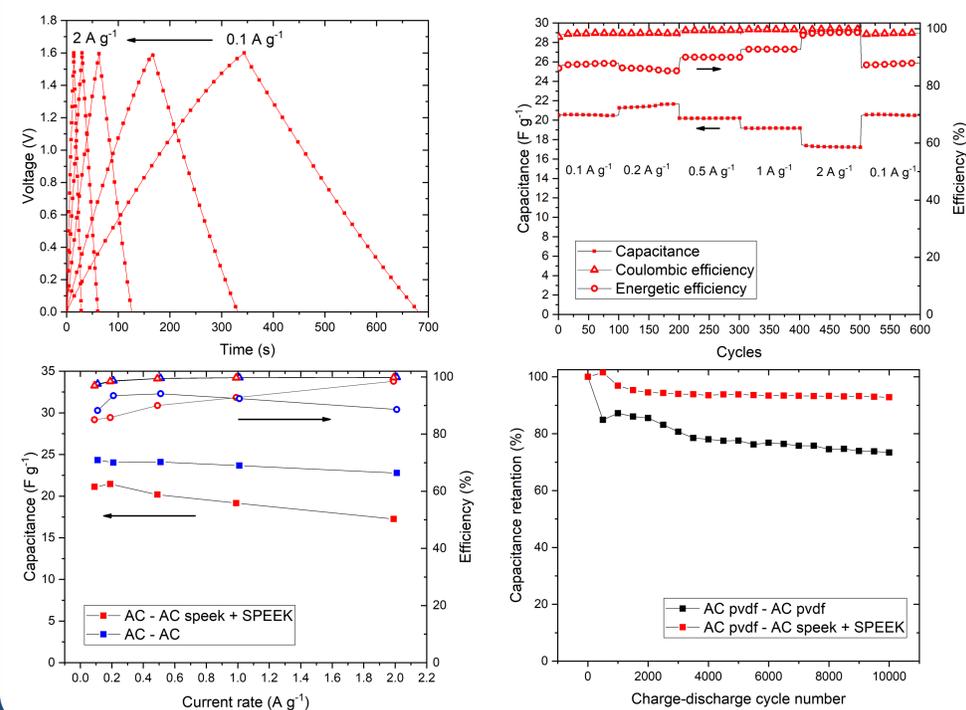
Positive electrode:

- PVDF binder
- No infiltrated IEM

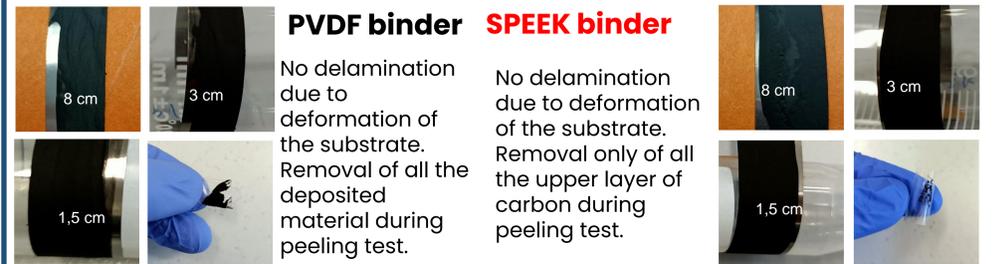
3 Electrodes measurements



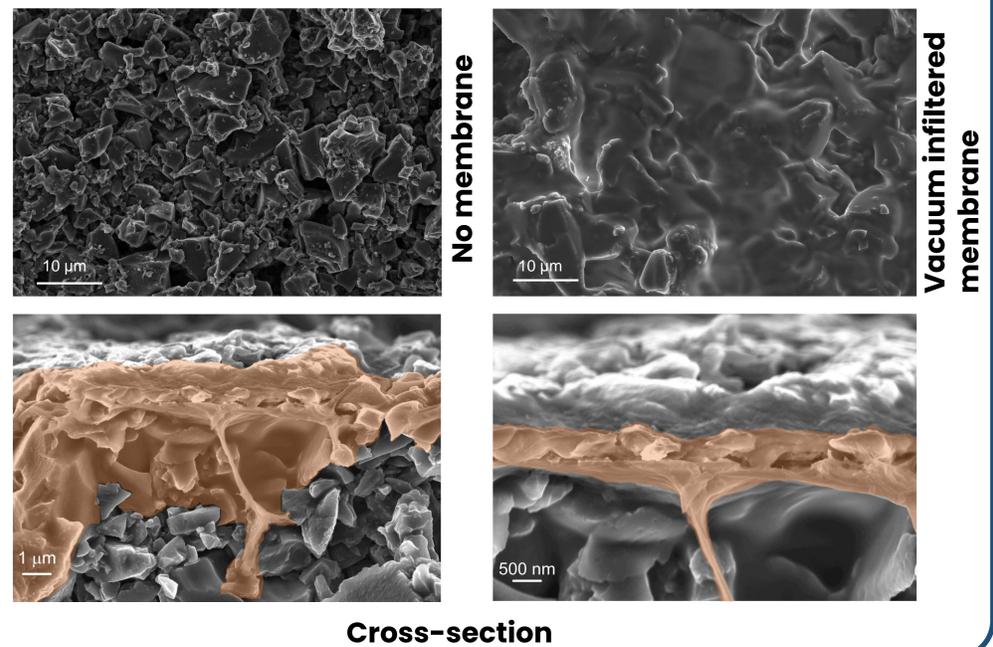
Device measurements



IEM as binder



IEM as conformal coating



Conclusions

- Newly proposed coating procedure to obtain thin membrane over carbon based materials
- Substitution of standard binder and improvement of the adhesion performances for supercapacitor electrode application
- Use of CEM in thin film over a carbon based electrode resulting in an enlargement in operating voltage window, increase in coulombic efficiency and reduction of ESR

Future outlooks

- Combination of SPEEK modified electrode with a AEM modified electrode
- Test the device inside a Capmix or RED cell

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Bibliography:

- [1] Sales, Bruno B., et al. <<Electrochemical characterization of a supercapacitor flow cell for power production from salinity gradients>> *Electrochimica acta*, 86 (2012) 298-304
- [2] Wang, Xingfeng, et al. <<A 1.8 V aqueous supercapacitor with a bipolar assembly of ion-exchange membranes as separator>> *Journal of The Electrochemical Society*, 163.9 (2016): A1853