Hybrid Silica-based Membrane for Energy application

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There are a variety of hybrid materials with polymeric or inorganic components whose properties depend on their chemical composition, their assembly and the control of polymer/inorganic interfaces. In the field of energy storage and conversion, the development of hybrid materials often responds to the difficulty of finding a material that satisfies all the criteria of conduction, mechanics and processability, etc.[1] The contradictory results of the literature in terms of properties underline how difficult it is to assemble them and how important it is to control and understand the organic/inorganic interfaces. Their chemical nature and structure are related to the forming processes and the associated chemistry.

In this talk, we will discuss the chemistry/process coupling to elaborate hybrid materials based on silica through examples in the field of energy conversion and storage. We will take an example around hybrid membranes with polymer components to see how it is possible to "copy" the nanostructuring of "Nafion", to reproduce its excellent conduction properties by giving it very good mechanical properties [2]. We will also focus on hybrid materials for energy storage in the context of batteries [3]. In particular, we will demonstrate the benefit of the silica-based chemistry to design smart separator to make safer and long-life batteries. Accordingly, the electrospun hybrid separator is modified by chemical functions allowing the chemical trapping of chemical species, coming from secondaries' reactions.

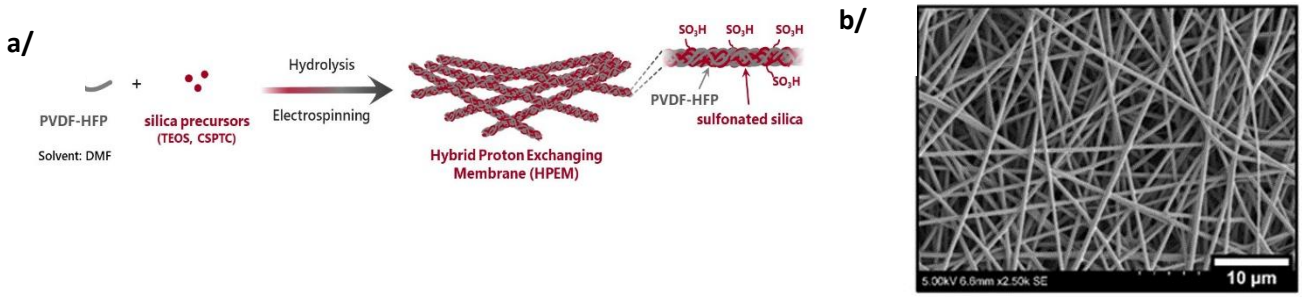

Figure 1. a) Scheme of the functional hybrid separators with its synthesis route. b) SEM images of the corresponding functional hybrid separators

Reference

[1] Design and properties of functional hybrid organic-inorganic membranes for fuel cells, C. Laberty-Robert, K. Vallé, F. Pereira, C. Sanchez, *Chemical Society Reviews,* 40(2), 961-1005, 2011.

[2] Proton transport in electrospun hybrid organic-inorganic membrane: an Illuminating paradox, L. Dos Santos, M. Maréchal, A. Guillermo, S. Lyonnard, S. Moldovan, O. Ersen, H. Perrot, C. Laberty-Robert, *Advanced Functional Materials*, 26, 4, 594-604, 2016.

[3] Thin Fiber-Based Separators for high Rate Sodium Ion batteries, L. Coustan, J.M. Tarascon, C. Laberty-Robert, *ACS Applied Energy Materials*, 2, 12, 8369-8375, 2019.