

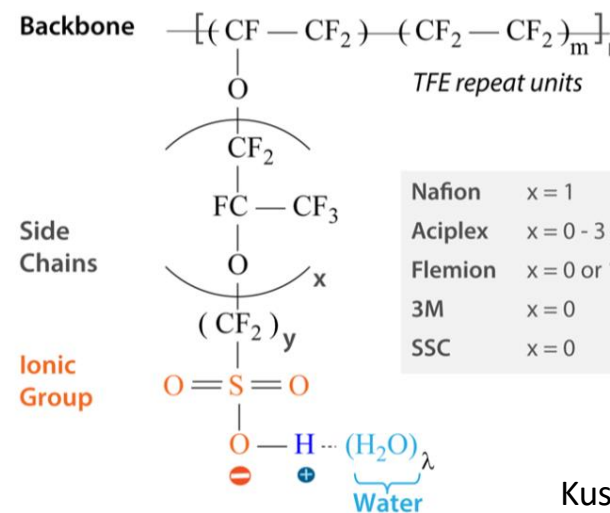
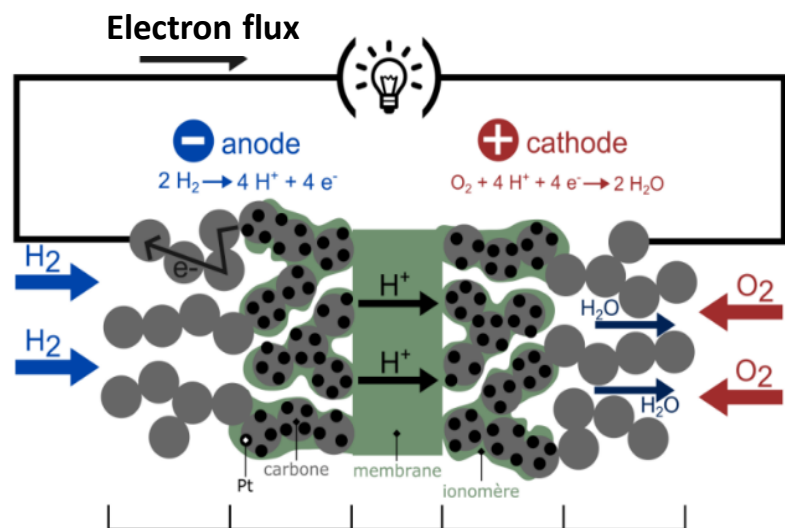
« Nouvelles » Membranes Hybrides Multifonctions



Prof. Christel Laberty-Robert

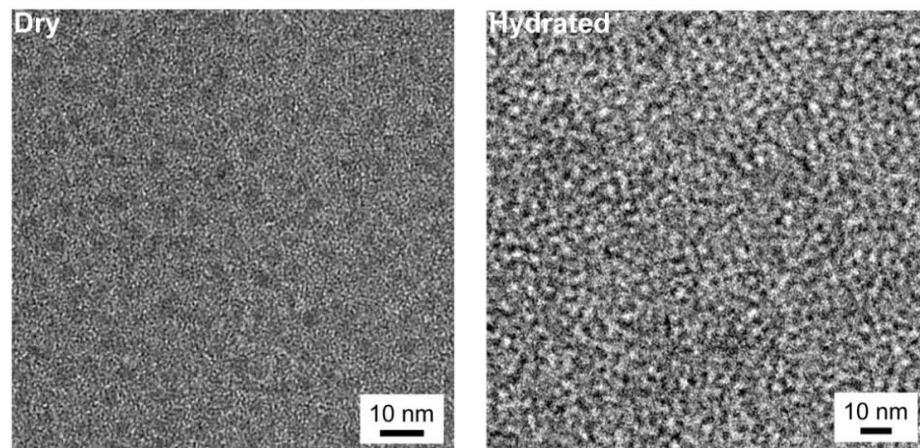
christel.laberty@sorbonne-universite.fr

L'hydrogène vecteur énergétique et réactif chimique

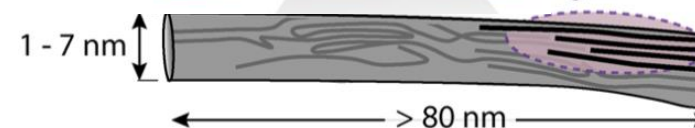
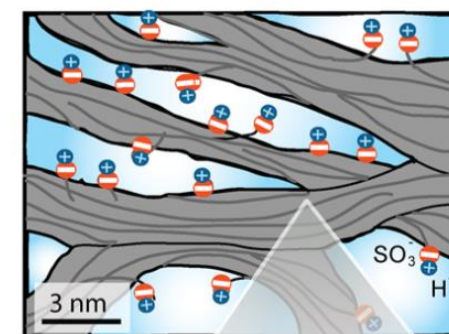
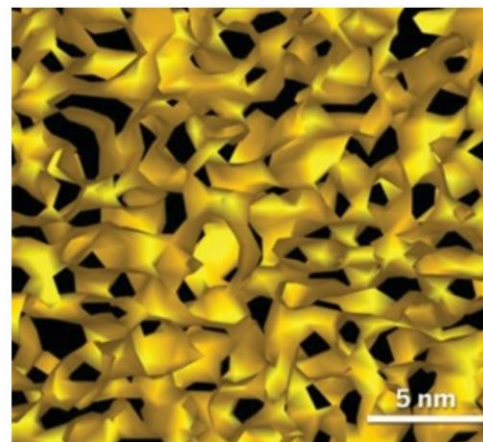


Kusoglu, *Chem. Rev.*117 (2017) 987–1104993

Rod-like Elongated Polymer Aggregates



Allen, *ACS MacroLett.* 4 (2015)1



Rubatat, *Macromolecules* 35 (2002) 4050

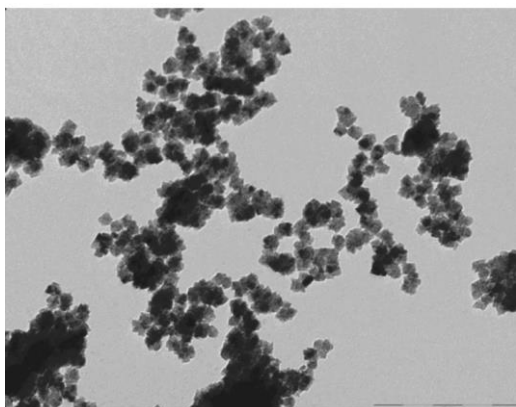
Improve performances (operating window, chemical stability)?

Chemical Stressors

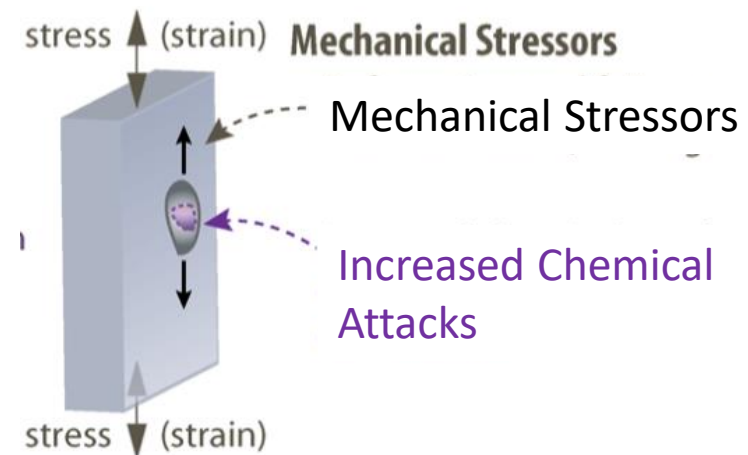
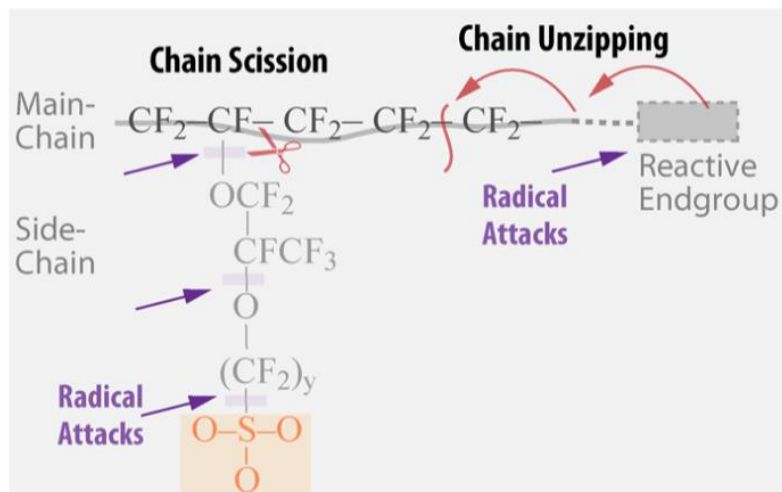


Radical Attack
 Chemical Decomposition
 Material loss and
 Defect formation

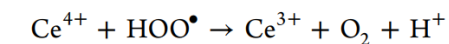
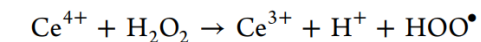
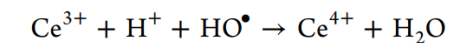
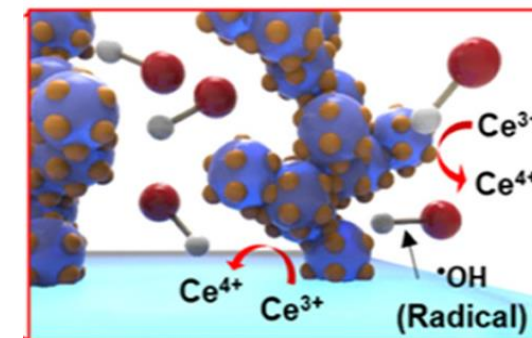
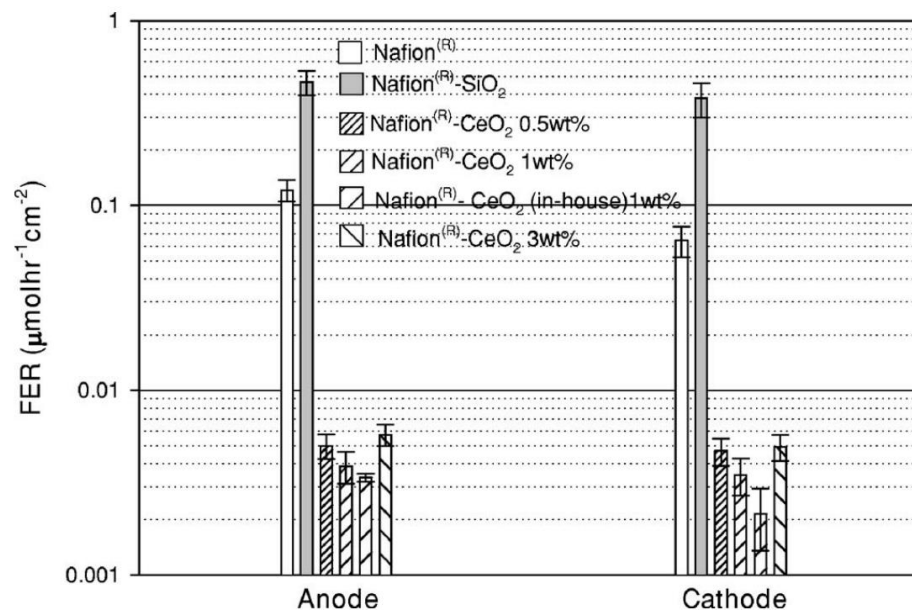
CeO₂



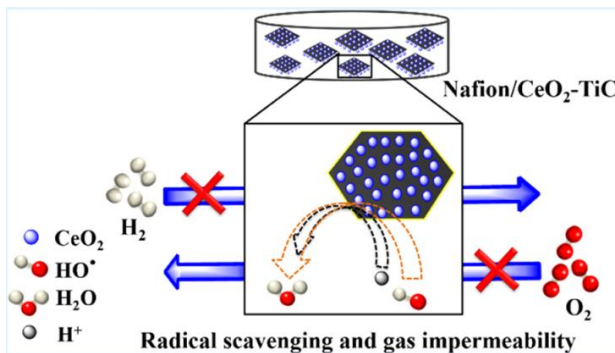
✓ 1–2 wt.% of Inorganics



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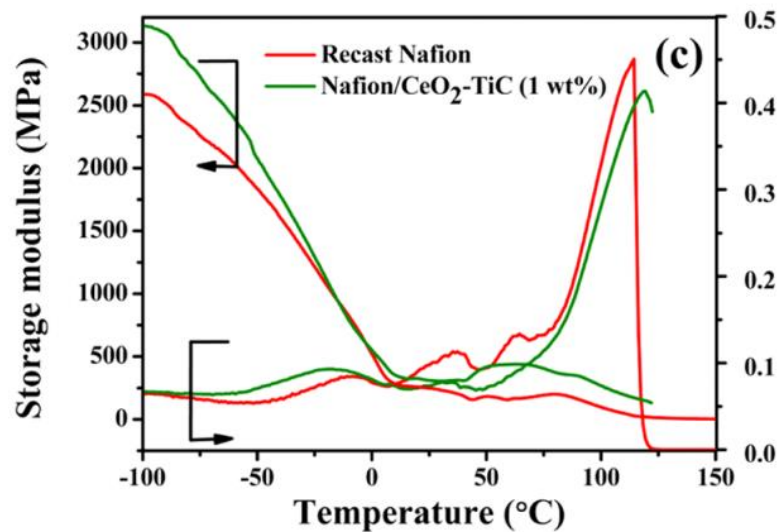


✓ 1 wt.% of Inorganics



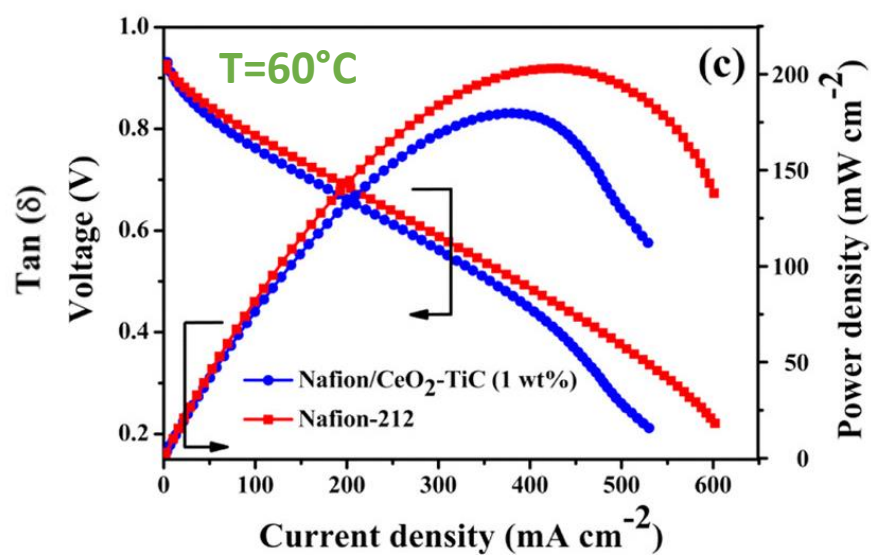
1

Improve Mechanical Properties



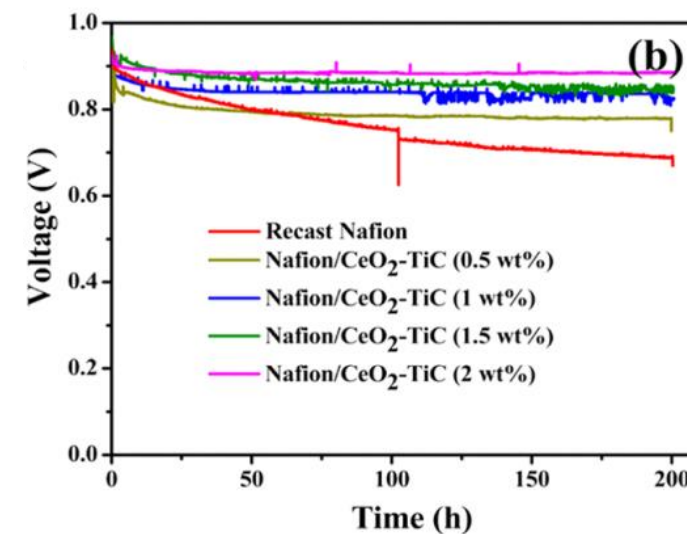
2

Keep Performances

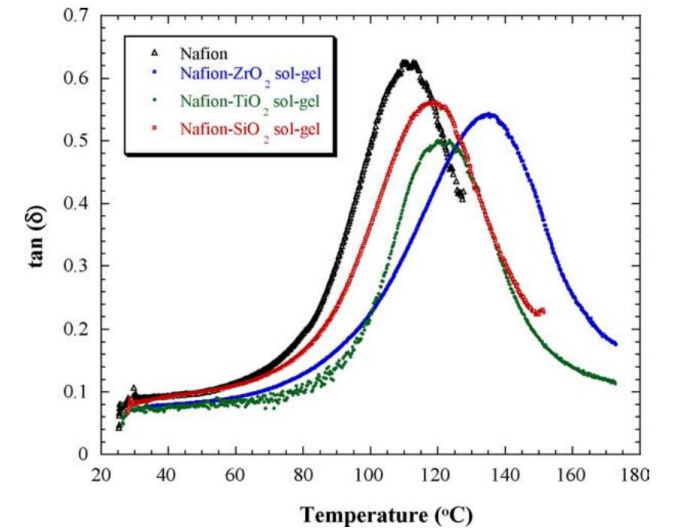
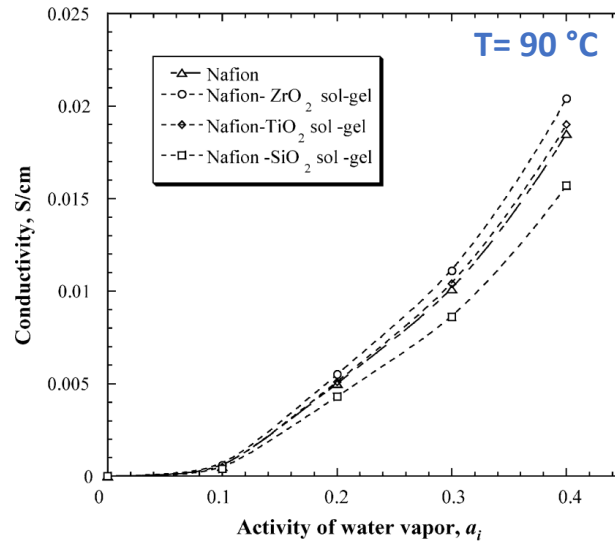
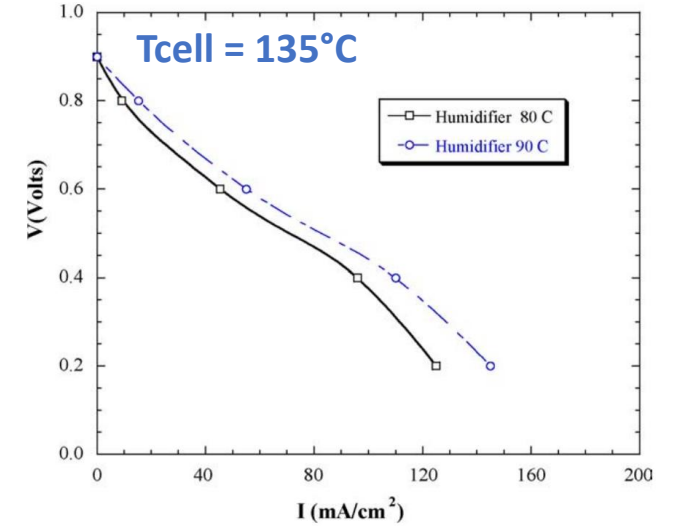
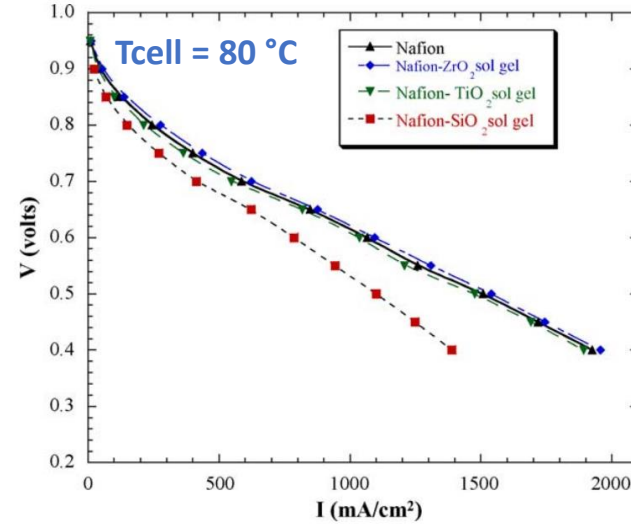
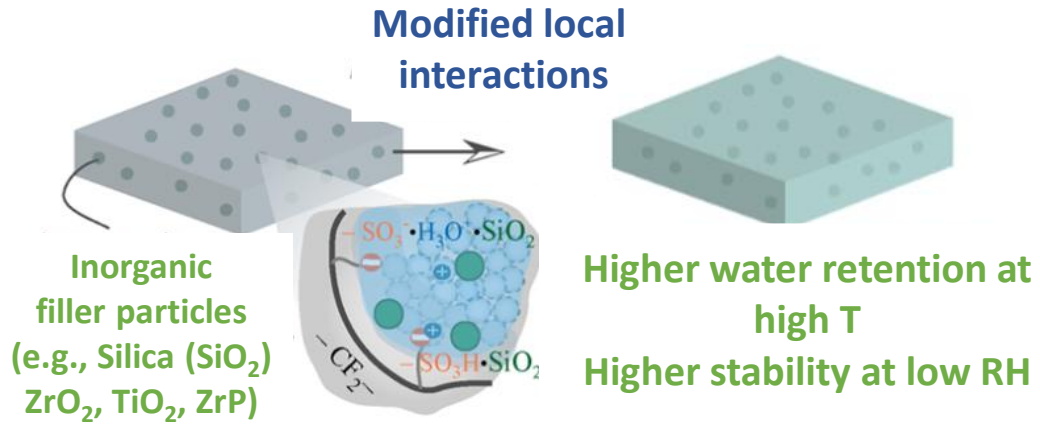


3

Enhance Stability



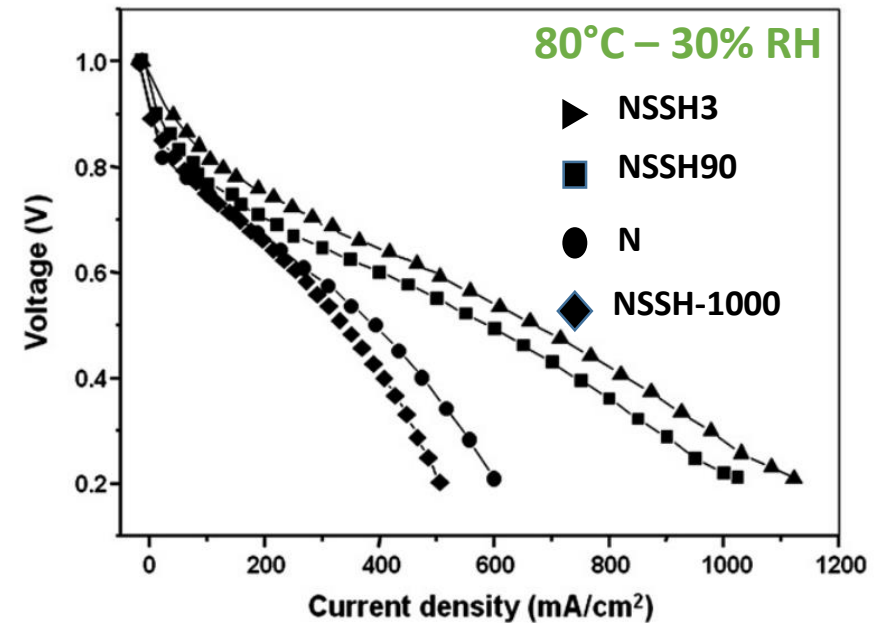
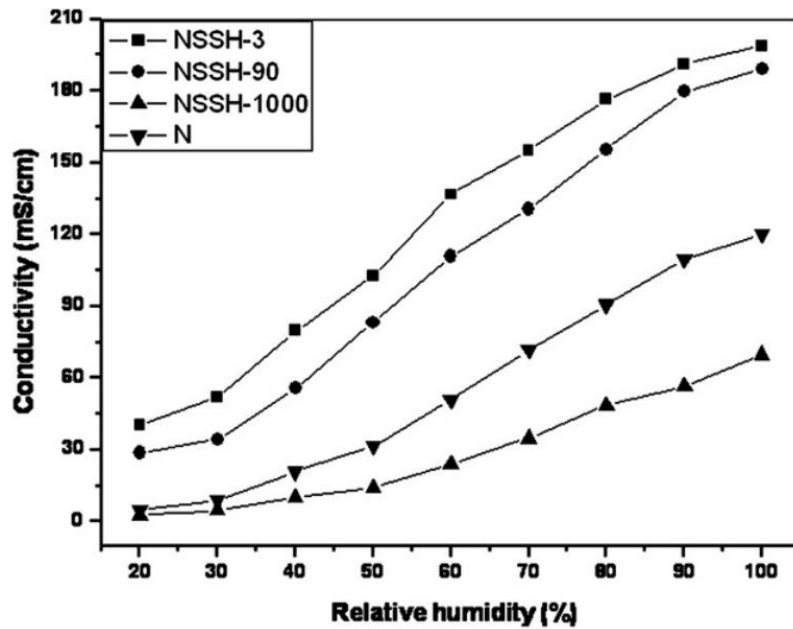
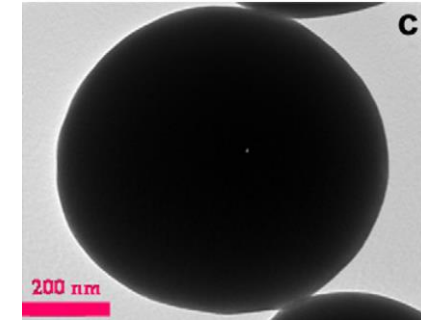
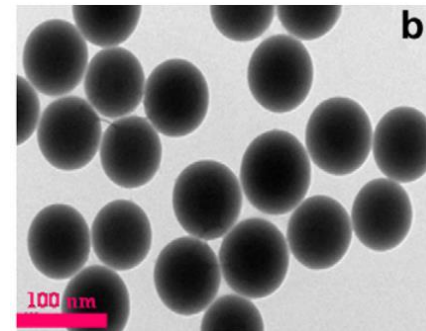
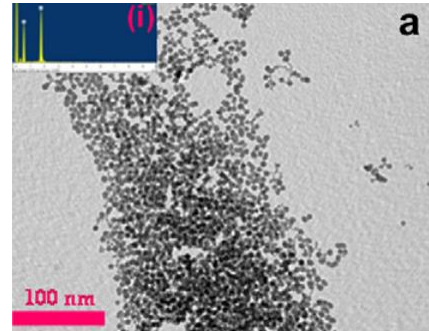
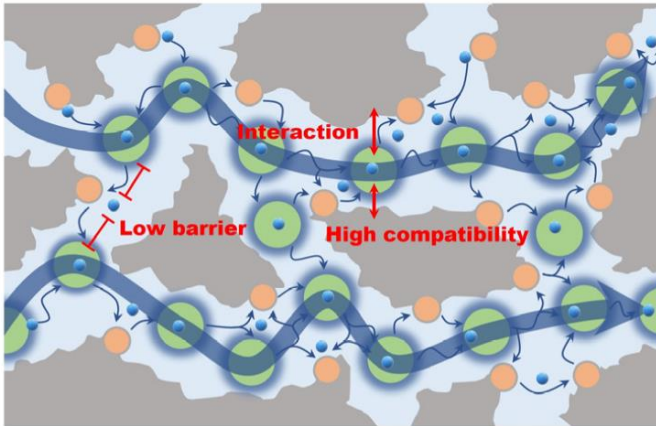
Inorganic Filler For Better Water Retention

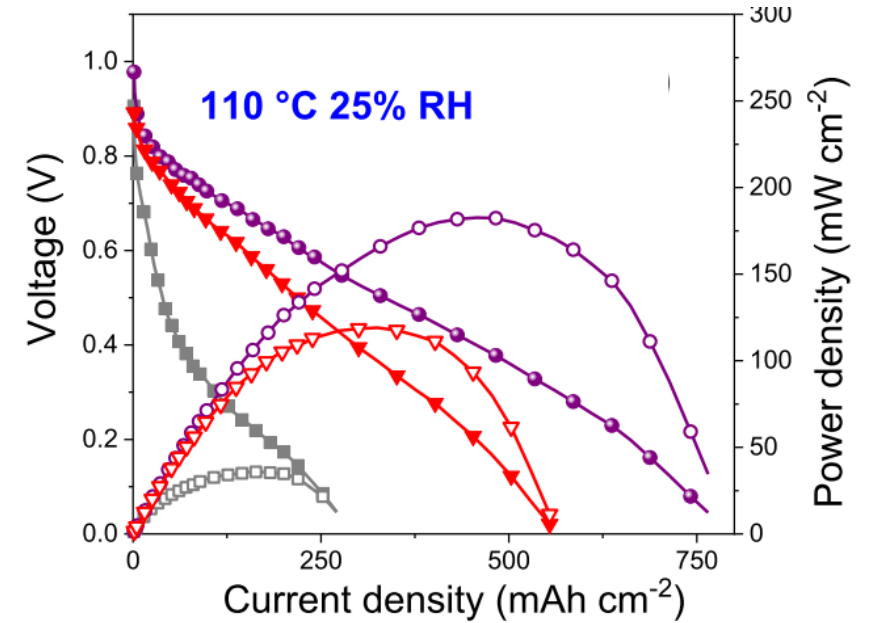
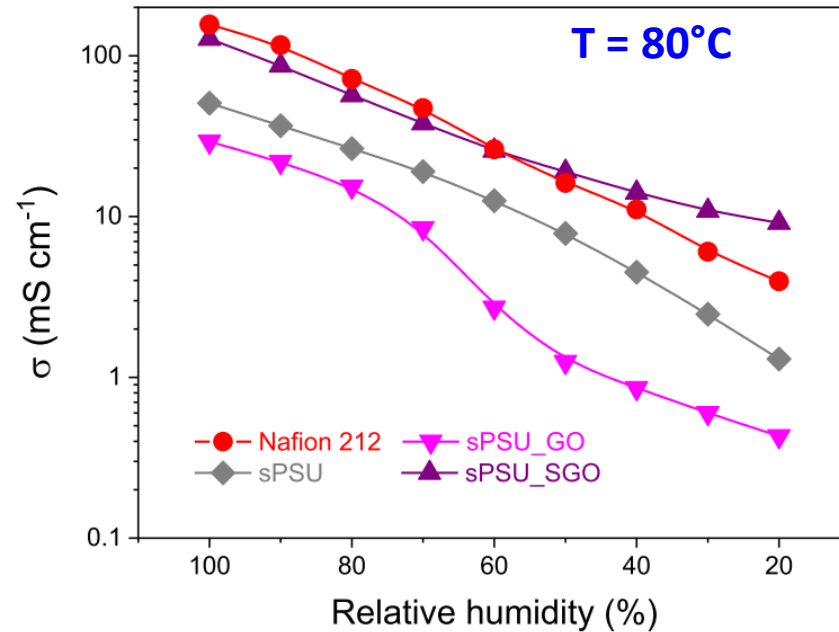
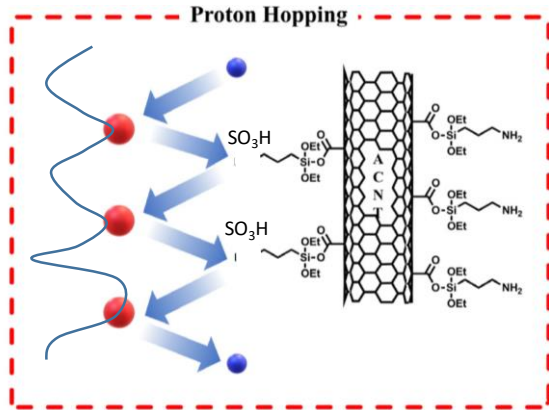
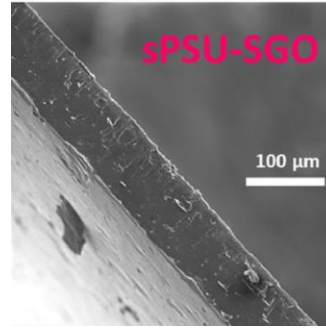
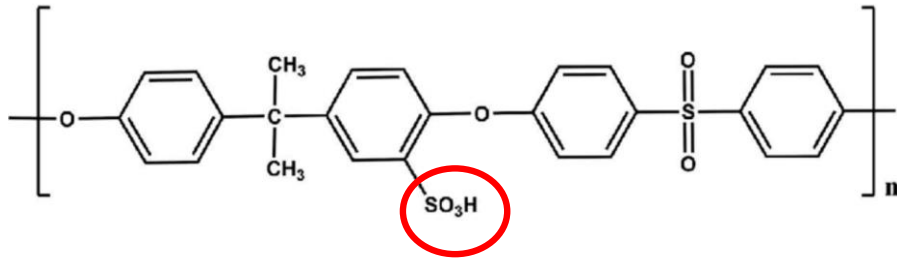


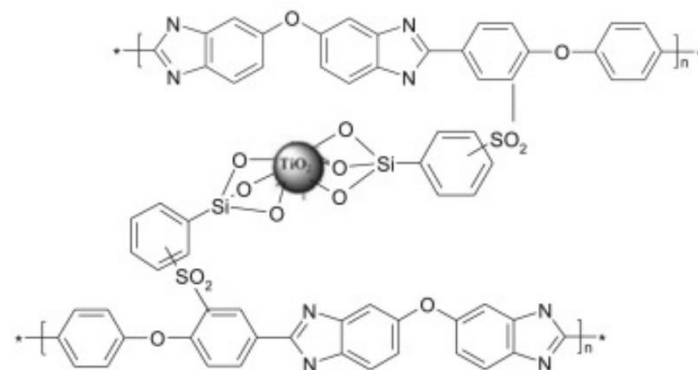
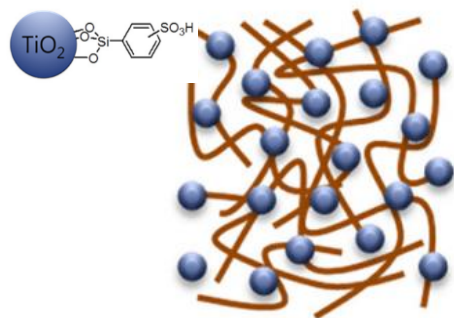
- ✓ Chemistry
- ✓ Concentration
- ✓ Morphology
- ✓ Processing

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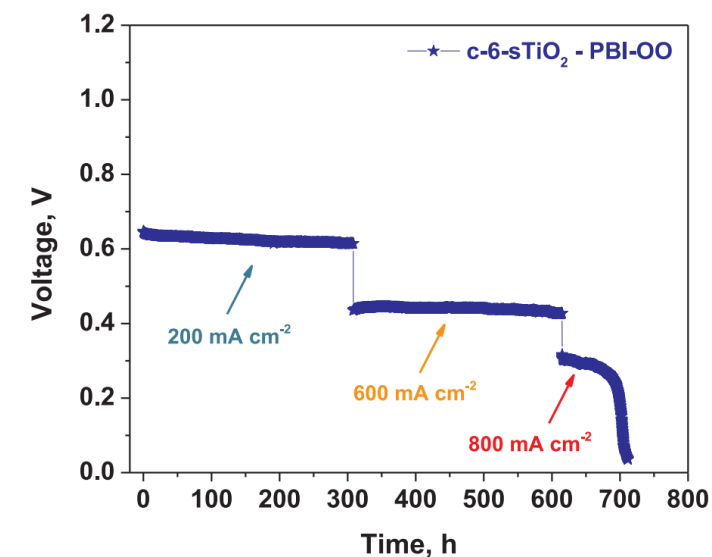
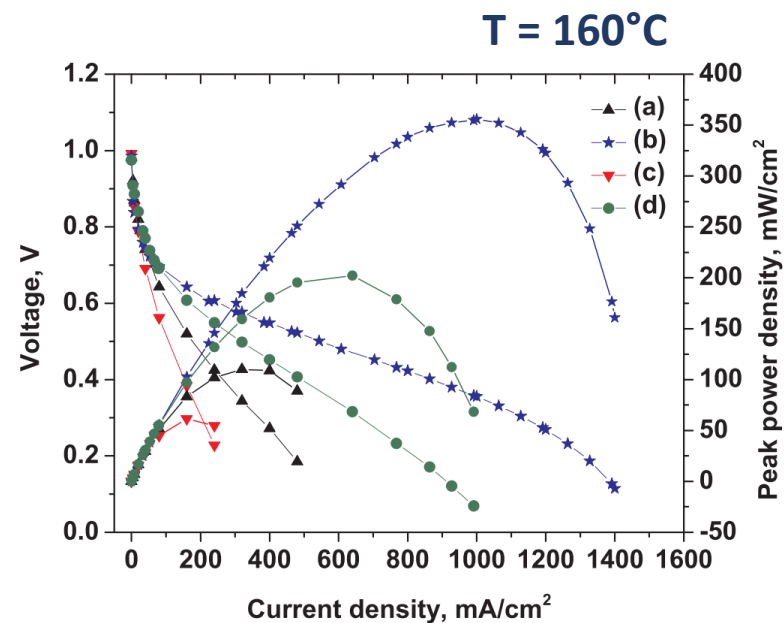
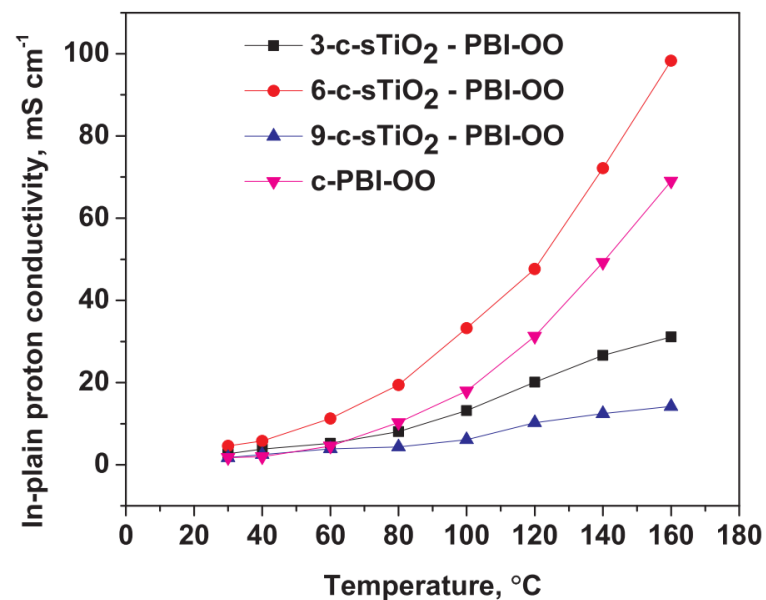
✓ **3–4 wt.% of Inorganics**

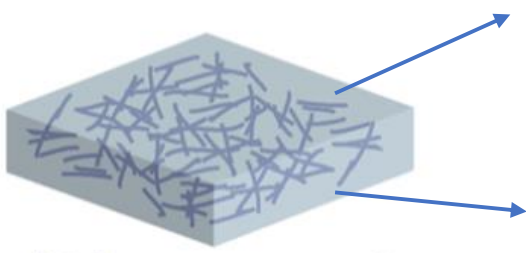




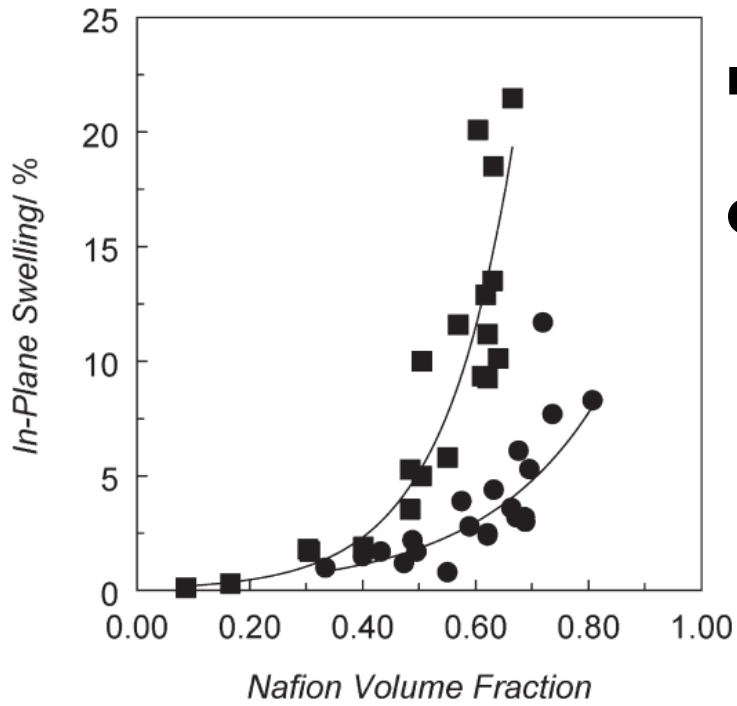


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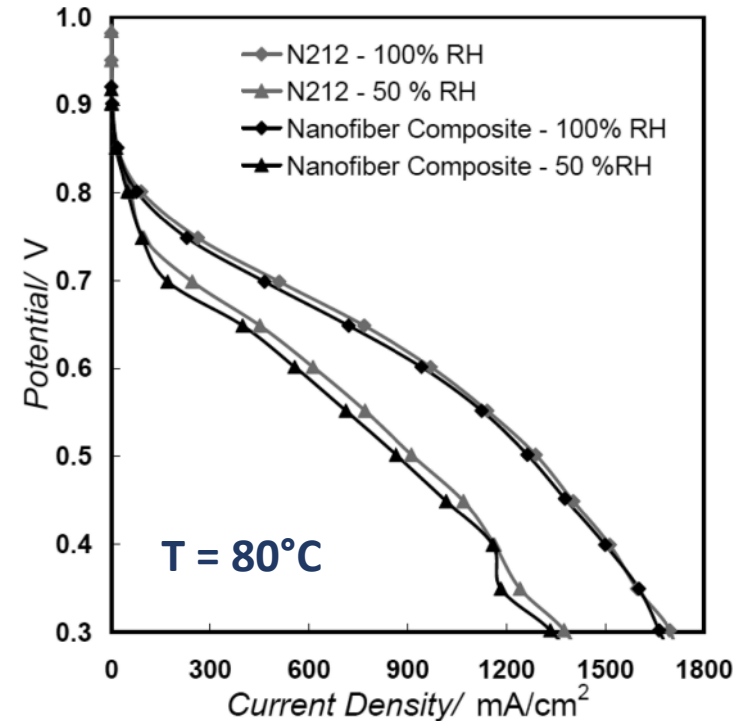




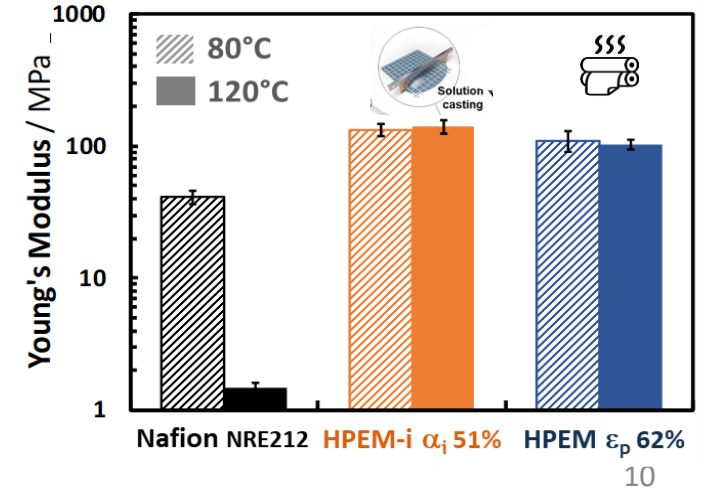
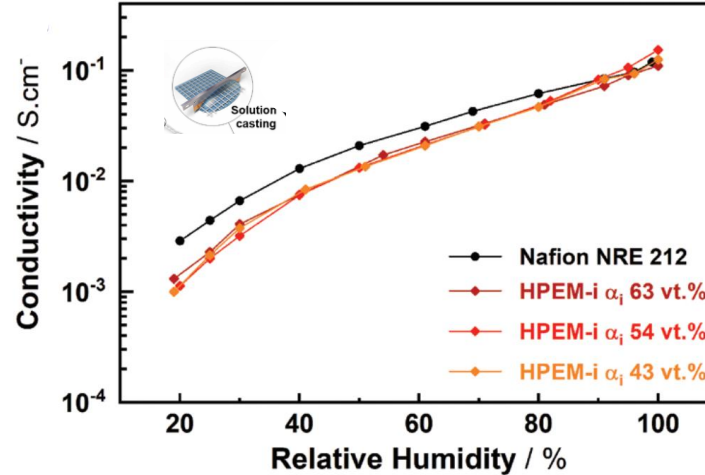
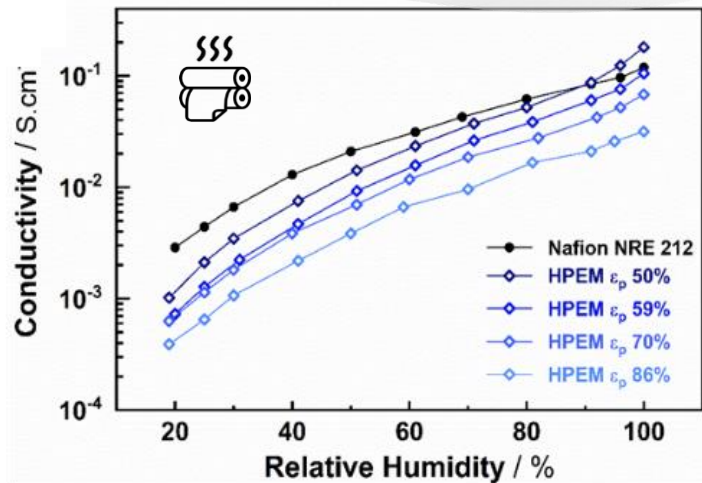
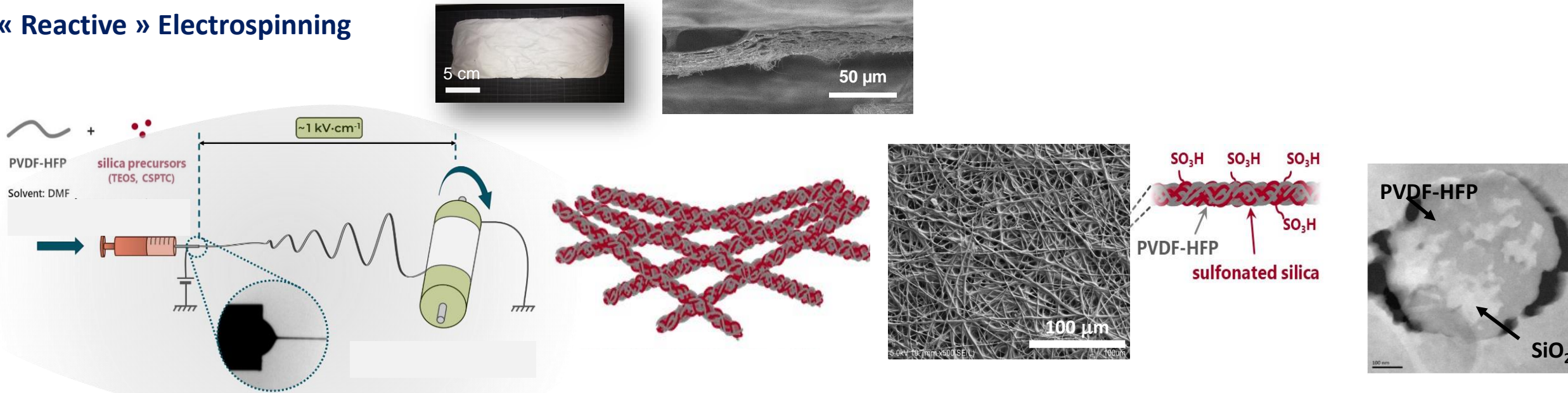
- ✓ **Fibers**
 Conducting or non conducting materials
 Inorganic materials
- ✓ **Matrix**
 Conducting or non conducting materials



- Nafion
 @ Polyphenylsulfone fibers
- Polyphenylsulfone
 @ Nafion fibers



« Reactive » Electrospinning



Conclusions and Remarks

- ✓ PFSA membranes « well-studied » and « well-known »
 - Chemistry
 - Composite for improving chemical/mechanical properties
 - How to bring the second «element (polymer, inorganic) » to polymer matrix ?

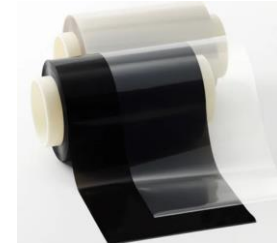
- ✓ Non-fluorinated membranes: limited studies available
 - Various Chemistries explored
 - Membranes allowing enlargement of operating window are designed
 PSU, PBI, and others....
 - Less studies on composites membranes

- ✓ Facilitating creative thinking through the consideration of the Membrane Electrode Assembly (MEA) and the entire process, which includes
 - Scalable, costly and appropriately green process
 - Integration of recycling practices

- ✓ Utilizing the electrolyte to assess the condition or health of the Membrane Electrode Assembly (MEA)

- ✓ Developing continuously operando tools to measure water profiles in the MEA

Gore select



PEMION



Acknowledgments

Students:

Ozlem Sel, Post-doc
Vasana Maneerathana, Post-doc
Leslie Dos Santos, Phd Student
Fatima Haidar, ATER
Jason Richard, Post-doc
Laura Coustan, Post-doc
Florent Leclercq, Post-doc

Collaborators

Natacha Krins
Damien Brégiroux
Arnaud Perez
Clément Sanchez

Manuel Maréchal,
Gérard Gébel
Sandrine Lyonnard
Hubert Perrot



Solvay, Symbio, Arkéma
ANR MéConPhry, ANR Eccentric
RSE2-DIM Respire