An innovative membrane reducing vanadium species crossover: scaleup and preliminary data characterization

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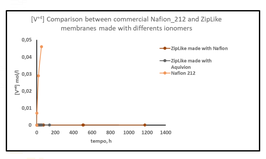
Introduction

The most used commercial membranes have not been developed for redox flow batteries and thus suffer for specific functional shortcomings as low selectivity, leading to vanadium ions permeation from one half cell to the other [1,2] causing decrease in coulombic efficiency and capacity decay during cycling [3]. The Patented innovative ZipLike Low Permeation membrane has been designed on purpose for vanadium flow batteries to reduce these problems [4].

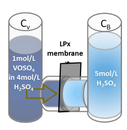
ZIPLIKE MEMBRANE FEATURES @ lab cell

Lower CrossOver

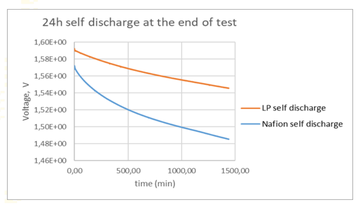
Crossover measurements in H-cell

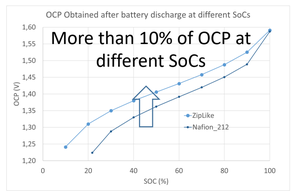


ICP

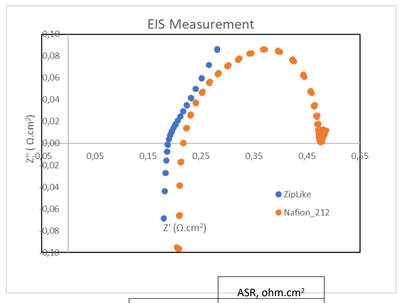


ZipLike decreases [V^{+4}] cross-over more than 1000 times compare to Nafion-212



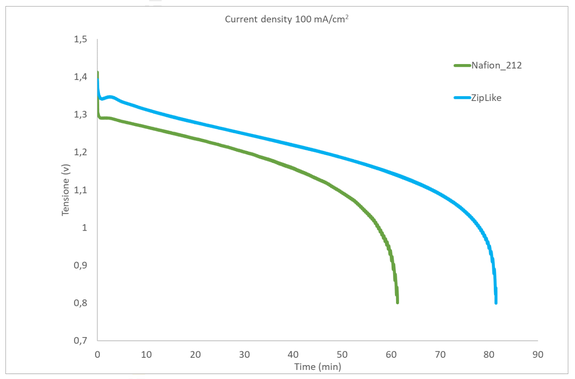


Better Performance



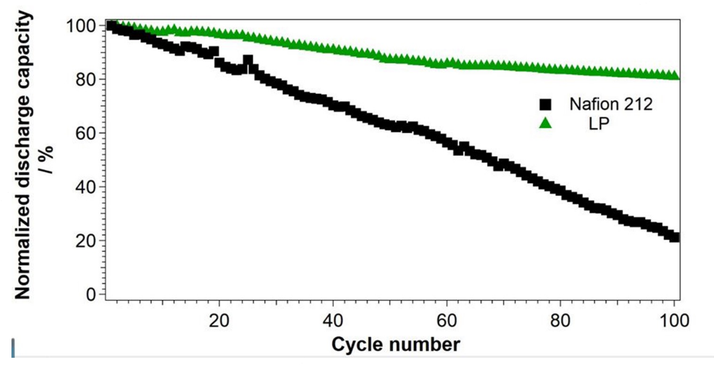
	ASR, ohm.cm²
Nafion_212	0,868
ZipLike	0,744

Low ASR of ZipLike compared to Nafion -212



Discharge Capacity increases

Greater capacity retention



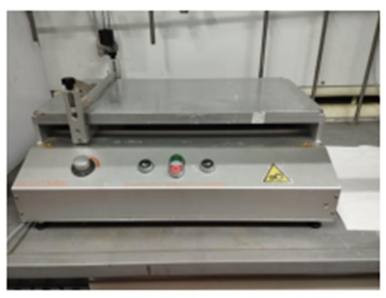
At current density of 25mA/cm²

ZIPLIKE MEMBRANE SCALEUP: SCREENING AND CHARACTERISATION

INVESTIGATION OF DIFFERENT PROCESSES FOR SCALE UP PURPOSES AND TEST CHARACTERIZATION

Scale up activities are on going to identify the best parameters (viscosity, drying time, drying atmosphere, etc….) for replicate the laboratory test results in large scale area (23*32,5)cm^2 membrane

Doctor blade



Slot Die Coater

R2R

Test to be carried out on a 23*32,5 membranes

FIRST MEMBRANE
19 cm x 23 cm;
50µm OBTAINED

Scope

1. FTIR study to determine the reproducibility of the membrane preparation through the study of the structure.
2. Water uptake and Swelling values
3. Mechanical properties of the membrane
4. Stability study with respect to oxidizing species

1. Quantify Water transfer across the membrane
2. Study of membrane stability in situ
3. Capacity retention versus cycles number
4. Cell performance

Conclusion

The first steps towards industrialization of Eni patented ZipLike membrane are underway:

- Scale-up from the laboratory scale to a semi-industrial process
- membrane testing and characterization according to a standard protocol.

References

[1]. Schwenzer B, Zhang JL, Kim S, Li LY, Liu J, Yang ZG. Membrane development for vanadium redox flow batteries. Chemsuschem 2011; 4: 1388–406
[2]. Li XF, Zhang HM, Mai ZS, Zhang HZ, Vankelecom I. Ion exchange membranes for vanadium redox flow battery (VRB) applications. Energy Environ Sci 2011; 4:1147–60.
[3]. Xiao Guang Yang, Qiang Ye, Ping Cheng, Tim S. Zhaao Effects of the electric field on crossover on ion in vanadium redox flow batteries. Applied Energy 145 (2015) 306-319
[4]. WO2021019497A1