

Polymer electrolytes using porous membrane made by electrospinning

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### Introduction

Polymer electrolytes with PVDF and P(VDF-HFP) have been actively studied. Also, phase inversion has been widely used to prepare polymer electrolytes with these polymers. Although porous matrix made by phase inversion is attractive material, phase inversion is not effective process.

Electrospinning is unique method to prepare porous polymer matrix with high porosity, large surface area, and three-dimension network. Also, this matrix shows good mechanical properties.

In this study, we suggest the application of electrospun PVDF and P(VDF-HFP) matrix for a polymer electrolyte.

### Results and Discussion

PVDF and P(VDF-HFP) matrices show high porosity, large surface area and three-dimensional structure with interconnected pores in Figure 1. PVDF matrix has smaller fiber diameter and pore size than P(VDF-HFP) matrix as shown in Table 1. Therefore, PVDF matrix has better uptake and retention ability of electrolyte solution than P(VDF-HFP). However, P(VDF-HFP) matrix shows more mechanically stable than PVDF due to their difference in phase separation state during electrospinning.

PVDF and P(VDF-HFP)-based polymer electrolytes is prepared by immersion of porous PAN matrices into the EC/EMC (v/v, 1/1) with 1M LiPF<sub>6</sub>, respectively.

Ionic conductivities of the polymer electrolytes were found to be as high as 10<sup>-3</sup> S cm<sup>-1</sup> at room temperature as shown in Figure 2. PVDF-based polymer electrolyte with small pore size shows better ionic conductivities than P(VDF-HFP)-based polymer electrolyte

PVDF-based polymer electrolyte has lower interfacial resistance than P(VDF-HFP)-based polymer electrolytes as shown in Figure 3.

Figure 4 shows the linear sweep voltammogram measured between 2.0 and 6.0 V. PVDF-based polymer electrolyte shows higher oxidation stability than P(VDF-HFP)-based polymer electrolyte.

### Conclusion

PVDF and P(VDF-HFP) are known to be similar affinity to electrolytes solution. Therefore, electrochemical properties of polymer electrolytes are mainly affected by structural factors of porous polymer matrix such as fiber diameter, pore size, pore structure. Difference in structural factors influences to uptake and retention ability of electrolyte solution. PVDF-based polymer electrolyte using porous polymer matrix with small diameter and larger surface area is more suitable than P(VDF-HFP)-based polymer electrolyte

### Reference

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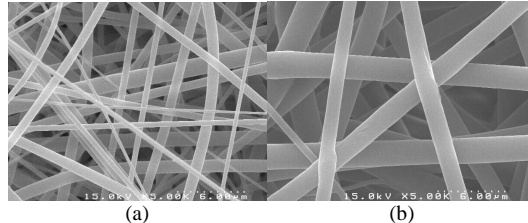


Figure 1. SEM images of (a) PVDF membrane and (b) P(VDF-HFP) membrane.

Table 1. Physical properties of PVDF and P(VDF-HFP) matrices.

Properties	PVDF	P(VDF-HFP)
Avr. fiber diameter ( $\mu\text{m}$ )	1.34	1.93
Apparent porosity (%)	88	78
% Strain Max. (%)	139	332
Max. Strength (MPa)	5.44	11.2

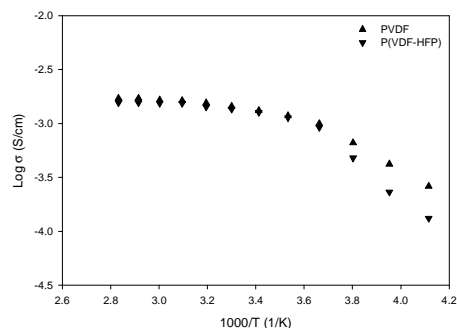


Figure 2. Ionic conductivities of PVDF and P(VDF\_HFP)-based polymer electrolytes.

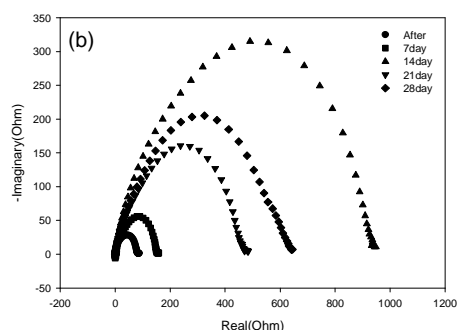
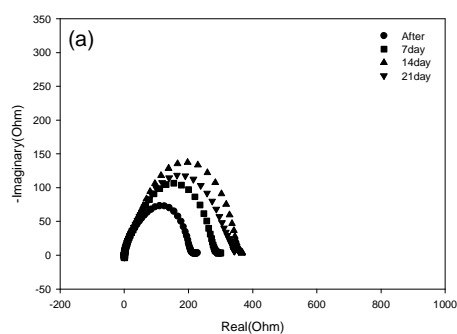


Figure 3. Interfacial resistances of PVDF and P(VDF-HFP)-based polymer electrolytes.

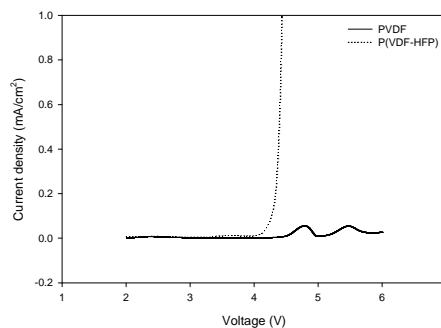


Figure 4. Electrochemical stabilities of PVDF and P(VDF-HFP)-based polymer electrolytes.