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Degradable cellulose acetate/ poly-L-lacticacid / halloysite nanotube composite nanofiber membranes with outstanding performance for gel polymer electrolytes

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The typical TEM image of the HNTs is shown in Fig. S1. The HNTs displayed a hollow tubular structure with the external diameter of 50-60 nm and lumen diameter of 12-15 nm.

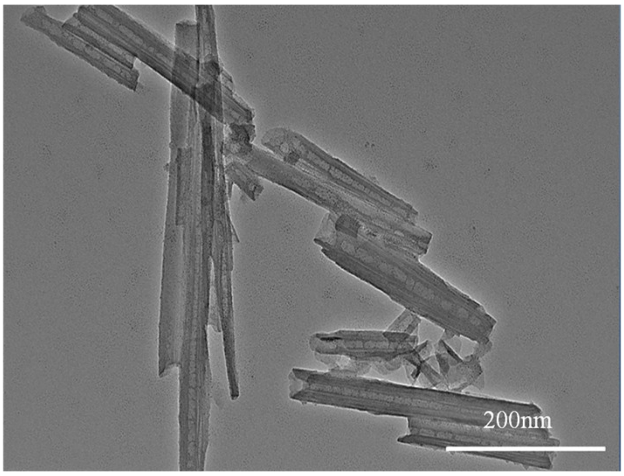

Fig. S1 TEM images of HNTs.

The Fig. S2 shows the details of the evolution of Ri of Li/GPE/Li cells with storage time. Shown as in the Fig. 6d, semi circles in the high frequency region and a straight linear line at low frequency region were observed. It can be seen that the highest Ri of the GPEs based on CA/PLLA nanofiber membranes was up to 900 Ω with the storage time, while the GPEs based on CA/PLLA/HNT nanofiber membranes only reached 720 Ω.

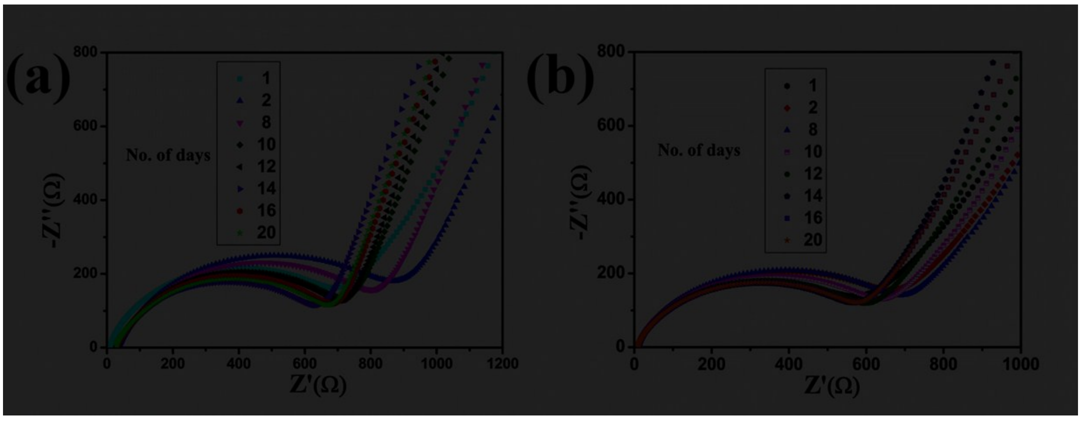

Fig. S2 The interface impedance spectra of Li/GPE/Li cells with storage time: (a) CA/PLLA nanofiber membranes; (b) CA/PLLA/HNT nanofiber membranes.

A Li/Li symmetric cell involving the CA/PLLA/HNT nanofiber membranes without liquid electrolyte was assembled and stored at 80 ℃ for a week. The surface morphology of the nanofiber membranes was observed by using a digital camera and SEM after disassembling the cell, as shown in the Fig. S3. It can be seen that the color of the composite membrane was not changed and the distinct nanofibers were displayed.

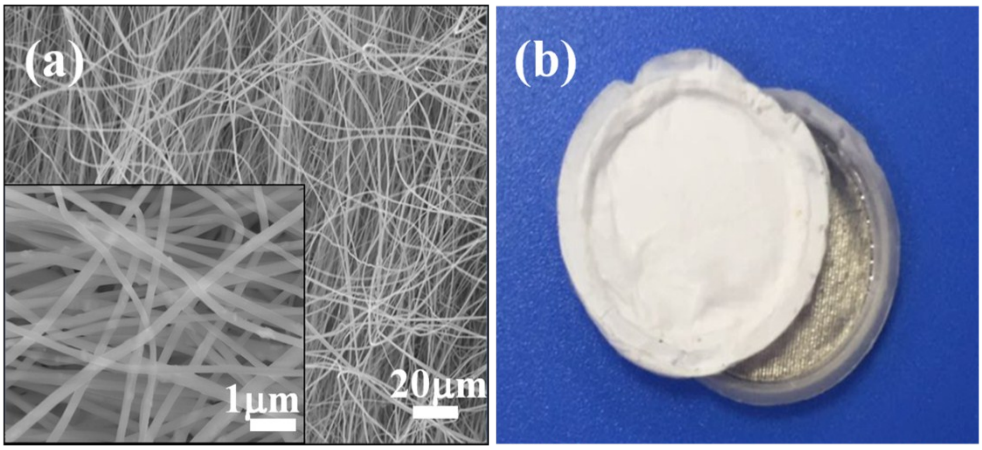

Fig. S3 The SEM images (a) and digital photograph (b) of the CA/PLLA/HNT nanofiber membranes after disassembling the Li/Li symmetric cell.

The Fig. S4 shows the morphological characterization of the dried GPE based on CA/PLLA/HNT membrane after 50 cycles. It can be seen the GPE displayed a compact structure and the indistinct nanofibers in the GPE were swelling due to the immersion of liquid electrolytes. The dried GPE was still a complete and folding small disc, as shown in the inset of Fig. S4, which maintained a certain mechanical strength.

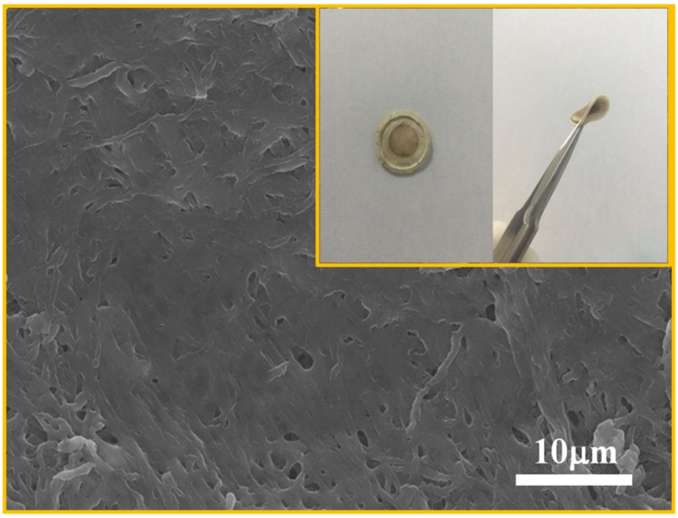

Fig. S4. The SEM image and digital photograph (shown as the inset) of the dried GPE based on CA/PLLA/HNT nanofiber membranes after 50 cycles

The Table S1 shows the comparison of porosity of the composite membranes in this study with some polymer membranes prepared by solution casting and phase inversion in the relevant reports.

Table S1 The comparison of porosity of some polymer membranes

Samples	Method	Porosity	Reference
Poly(vinylidenefluoride-co-hexafluoropropylene)	Solution casting	27	[S1]
Carboxymethyl cellulose	Solution casting	62.5	[S2]
Hydroxyethyl cellulose	Solution casting	0.063	[S3]
Poly(vinylidene fluoride)	Phase inversion	63	[S4]
Cellulose acetate/poly-L-lacticacid/halloysite nanotubes	Electospinning	87	This work

References

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[S4] T. Ma, Z.Y. Cui, Y. Wu, S.H. Qin, H. Wang, F. Yan, N. Han and J.X. Li, J. Membr. Sci., 2013, 444, 213–222.