Electronic supplement information (ESI)

Thermostable and nonflammable silica-polyetherimide-polyurethane nanofibrous separators for high power lithium ion batteries

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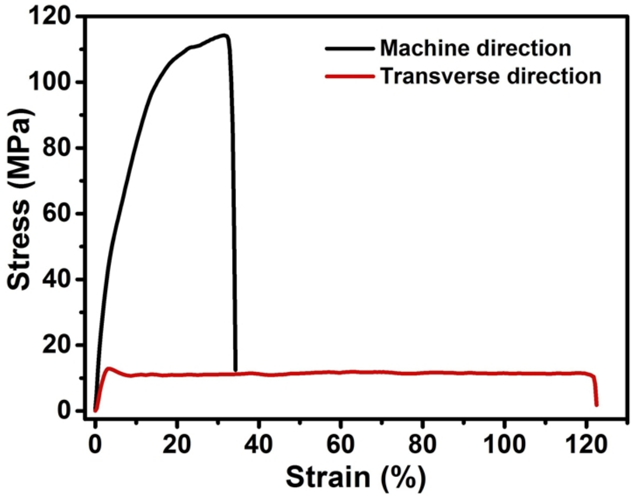

Fig. S1 Stress-strain curves of the Celgard membrane.

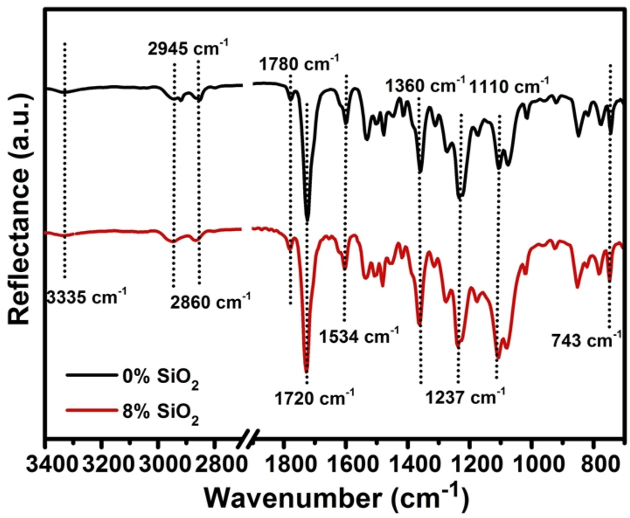

Fig. S2 FT-IR spectra of SiO_2-PEI-PU nanofibrous membranes.

The FT-IR spectra of the SiO_2-PEI-PU nanofibrous membranes are shown in Fig. S2. The absorption spectra exhibit characteristic imide group absorptions at 1780 and 1720 cm^{-1} (asymmetrical and symmetrical stretching of imide carbonyl bond), 1360 and 743 cm^{-1} (C-N stretching and bending), and 1237 cm^{-1} (aromatic ether C-O-C).[1] The typical absorption features for carbamate group were found at 3335 cm^{-1} (hydrogen-bonded N-H stretching), 1720 cm^{-1} (stretching vibrations of C=O), 1534 cm^{-1} (CO-N-H bending), 1110 cm^{-1} (C-O-C), 2945 and 2860 cm^{-1} (asymmetrical and symmetric stretching of CH_2), respectively.[2] Meanwhile, the increased band intensity at 1110 cm^{-1} of SiO_2-PEI-PU membranes containing 8 wt% SiO_2 NPs may be ascribed to Si-O-Si stretching, which implies that the introduction of SiO_2 NPs.

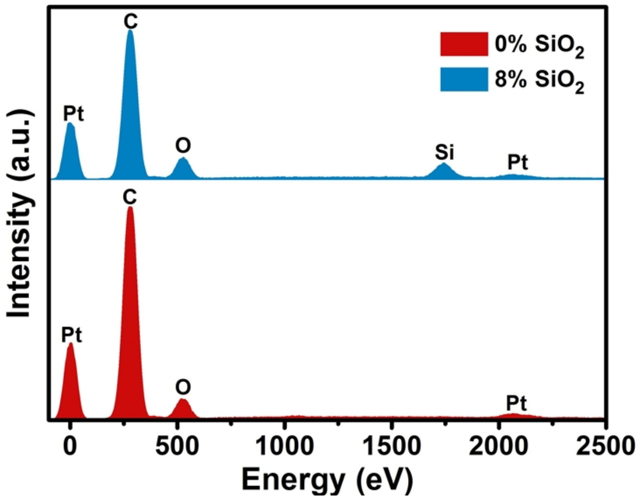

Fig. S3 EDX spectra of SiO_2-PEI-PU nanofibrous membranes.

Further confirmation of the involvement of SiO_2 NPs has done by the energy-dispersive X-ray spectroscopy (EDX). Fig. S3 shows the typical EDX pattern for PEI-PU and SiO_2-PEI-PU nanofibrous membranes. Note that Pt signals come from the sputter-coating gold film. The EDX pattern for the SiO_2-PEI-PU membranes containing 0 wt% SiO_2 NPs do not show the characteristic signal of Si, whereas for the SiO_2-PEI-PU nanofibrous membranes containing 8 wt% SiO_2 NPs a clear signal of the presence of Si has been observed. All of these indicate that the successful introduction of SiO_2 NPs in the SiO_2-PEI-PU membranes.

References

1. A. Choudhury, *Mater. Chem. Phys.*, 2010, **121**, 280.
2. J. Wang, Y. Li, H. Tian, J. Sheng, J. Yu and B. Ding, *RSC Adv.*, 2014, **4**, 61068.