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

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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). 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. 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.

![EDX spectra of SiO$_2$-PEI-PU nanofibrous membranes.](image)

**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**