Supplementary Material

A porous diatomite ceramic separator for lithium ion batteries

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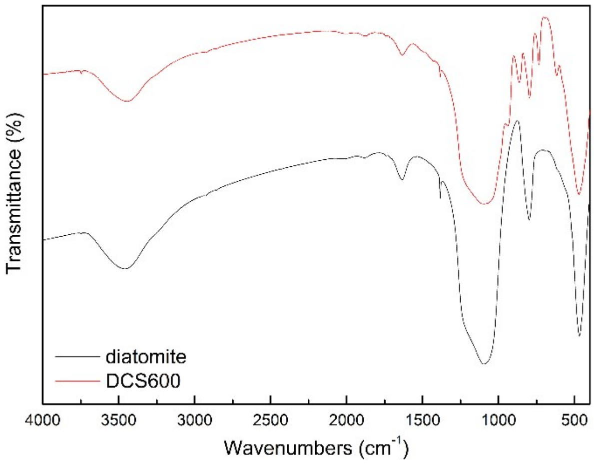

Fig. S1 FTIR spectra of diatomite and DCS600

FTIR spectra of diatomite and DCS600 are presented in Fig. S1. Compared with diatomite, new bands at nearly 632, 735, 863 and 935 cm^{-1} in the FTIR spectrum of DCS600 are related to Si-O-Si symmetric and asymmetric stretching [1-3], indicating the presence of silicate in DCS600 sample.

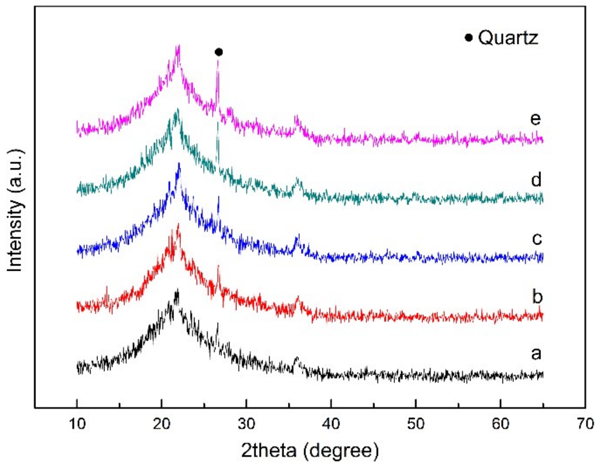

Fig. S2 XRD patterns of (a) diatomite, calcined diatomite at (b) 600 ˚C, (c) 700 ˚C, (d) 800 ˚C, (e) 900 ˚C

In order to investigate the influence of calcination temperature on the silica phase transition in diatomite from amorphous phase to crystalline quartz, diatomite was calcinated at 600, 700, 800 and 900 °C, respectively, according to the calcination conditions of diatomite ceramic separator. Fig. S1 shows the XRD patterns of calcined diatomite at different temperature. As can be seen from Fig. S1, with the increase of calcination temperature, the diffraction peak intensities of quartz in the XRD patterns of calcined diatomite (Fig. S1b, c, d, e) have an increasing trend, which indicates that the increase of calcination temperature is beneficial to promote the transition in diatomite from amorphous phase to crystalline phase.

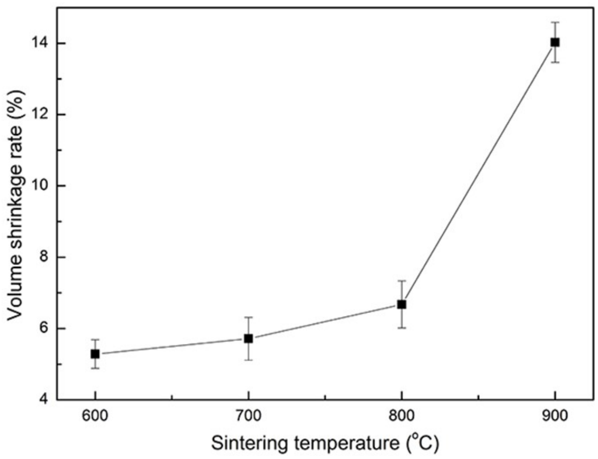

Fig. S3 Volume shrinkage rates of diatomite ceramic separators from ceramic bodies at different calcination temperature

Volume shrinkage rate of diatomite ceramic separator was calculated by the Eq (7):

Volume shrinkage rate (%) = $(A_0 - A) / A_0 \times 100\%$ (7)

where A_0 and A are the areas of diatomite ceramic separator before and after calcination, respectively. It is obvious that with the increase of calcination temperature, the volume shrinkage rate of ceramic separator increases gradually. Especially at 900 ˚C, the volume shrinkage rate of DCS900 sample increases sharply.

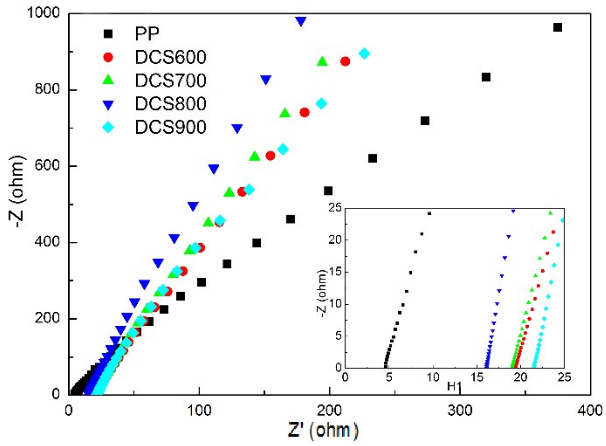

Fig. S4 Nyquist curves of different ceramic separators

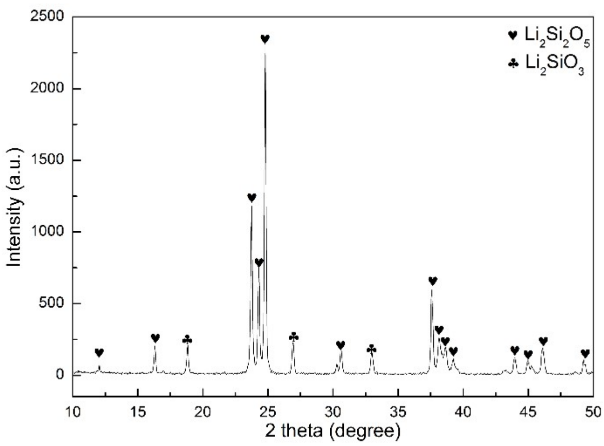

Fig. S5 XRD pattern of $Li_2Si_2O_5$ ceramic separator prepared from SiO_2 and LiOH at the mass ratio of 60/40 (*w*/*w*)

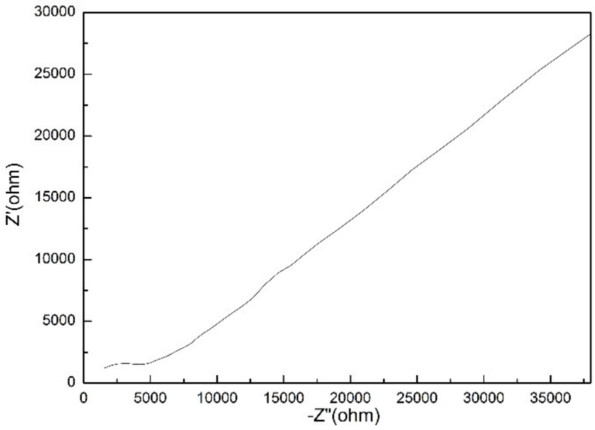

Fig. S6 Nyquist curve of $Li_2Si_2O_5$ ceramic separator prepared from SiO_2 and LiOH at the mass ratio of 60/40 (*w*/*w*)

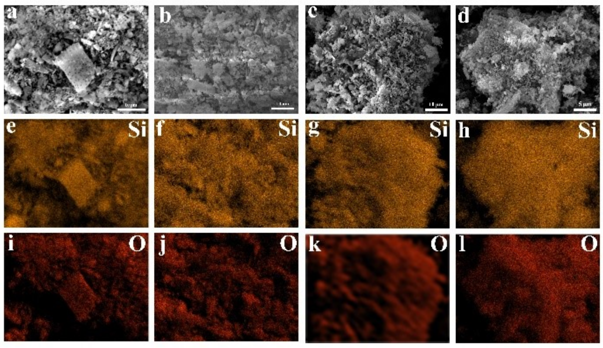

Fig. S7 EDX images of DCS ceramic separators sintered at different temperatures (a,e,i) DCS600, (b,f,j) DCS700, (c,g,k) DCS800, (d,h,l) DCS900, Among them (e, f, g, h) is the distribution map of Si element, (i, j, k, l) is the distribution map of O element

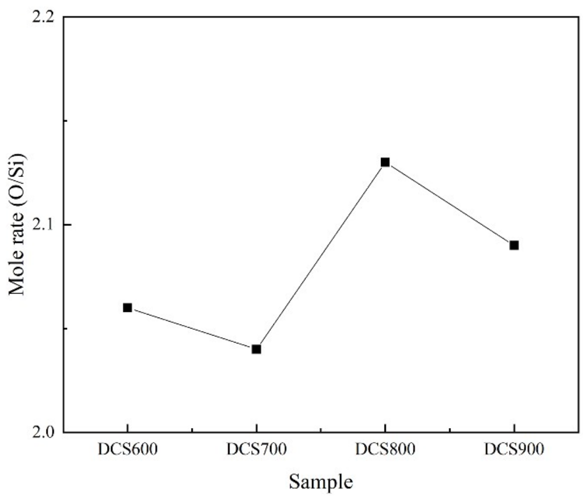

Fig. S8 The atomic ratio of O/Si in the EDX spectra of samples sintered at different temperatures

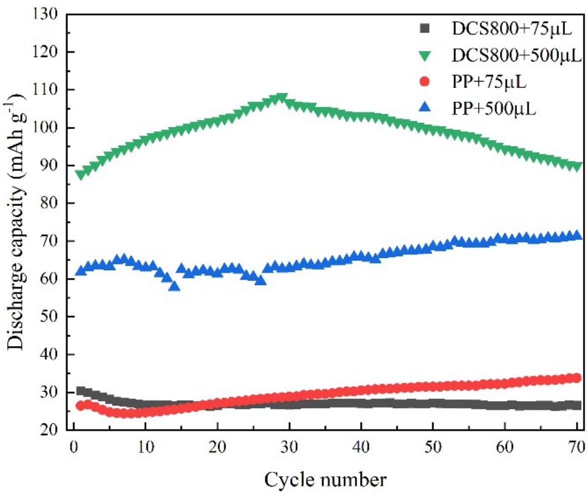

Fig. S9 The specific discharge capacity of cells with PP and DCS800 ceramic separator at 10C after adding 75 μL and 500 μL electrolyte, respectively

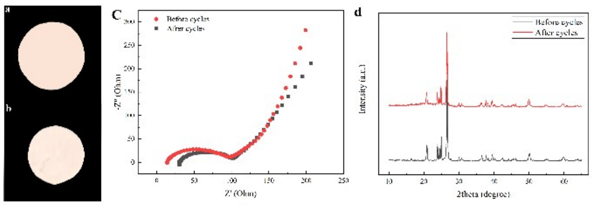

Fig. S10 Comparison of DCS800 ceramic separator before and after 200 cycles: (a) digital photo of DCS800 before cycle, (b) digital photo of DCS800 after cycle, (c) Nyquist curves of DCS800 before and after cycle, (d) XRD patterns of DCS800 before and after cycle

References

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