Supplementary Data

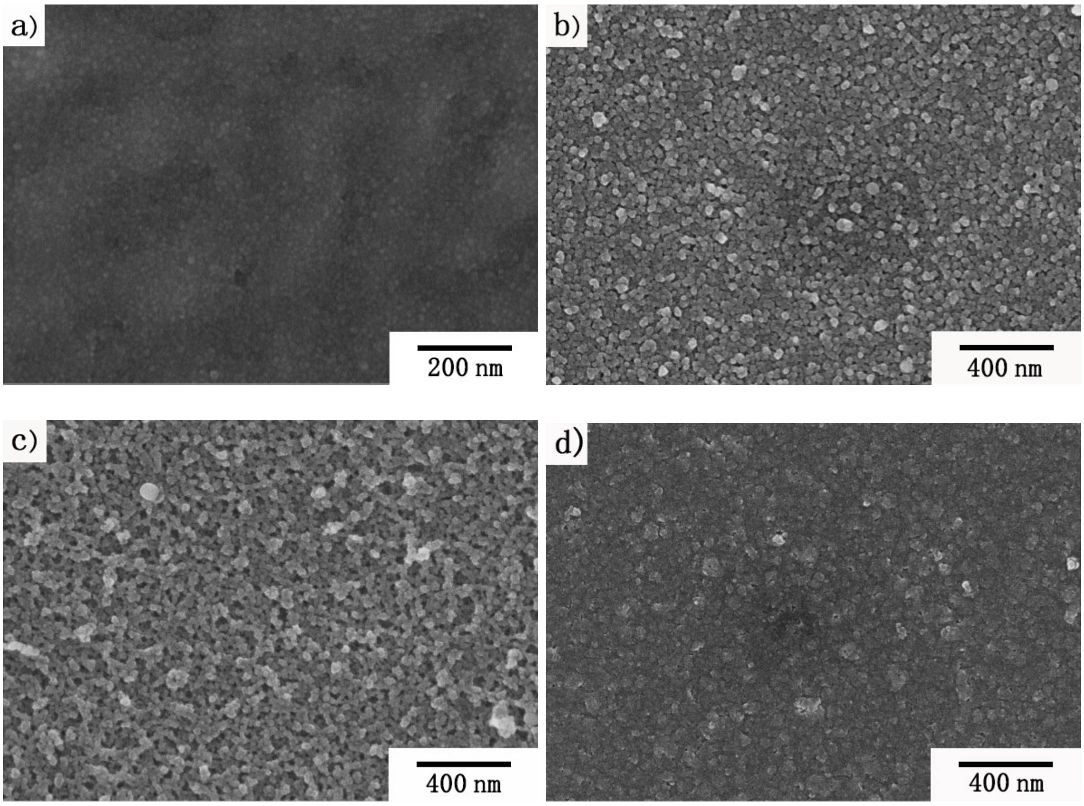

Figure. S1 SEM micrographs show the influence of different hydrolysis times on the microstructure of the silica aerogel films: a) hydrolysed for 1 h, b) hydrolysed for 2 h, c) hydrolysed for 3 h, d) hydrolysed for 4 h

Figure. S1 shows that the microstructure of the aerogel films is almost dependent of hydrolysis time. The inadequate hydrolysis resulted in phase separation and sedimentation of solid particles due to sudden condensation of the sol before completion of hydrolysis, according to Figure. S1 (a). As the hydrolysis time increased from 2 hours to 3 hours, the degree of cross-linked by the primary particles increased, as shown in the Figure. S1 (b) and (c). More-porous and low-density aerogel films with less volume shrinkage were obtained for the hydrolysis time equal to 3 h. However, further prolonging the hydrolysis time resulted in the formation of a dense silica film. (Figure. S1 (d)). It can be attributed to the fact that a sufficient degree of hydrolysis led to faster condensation before the addition of base.

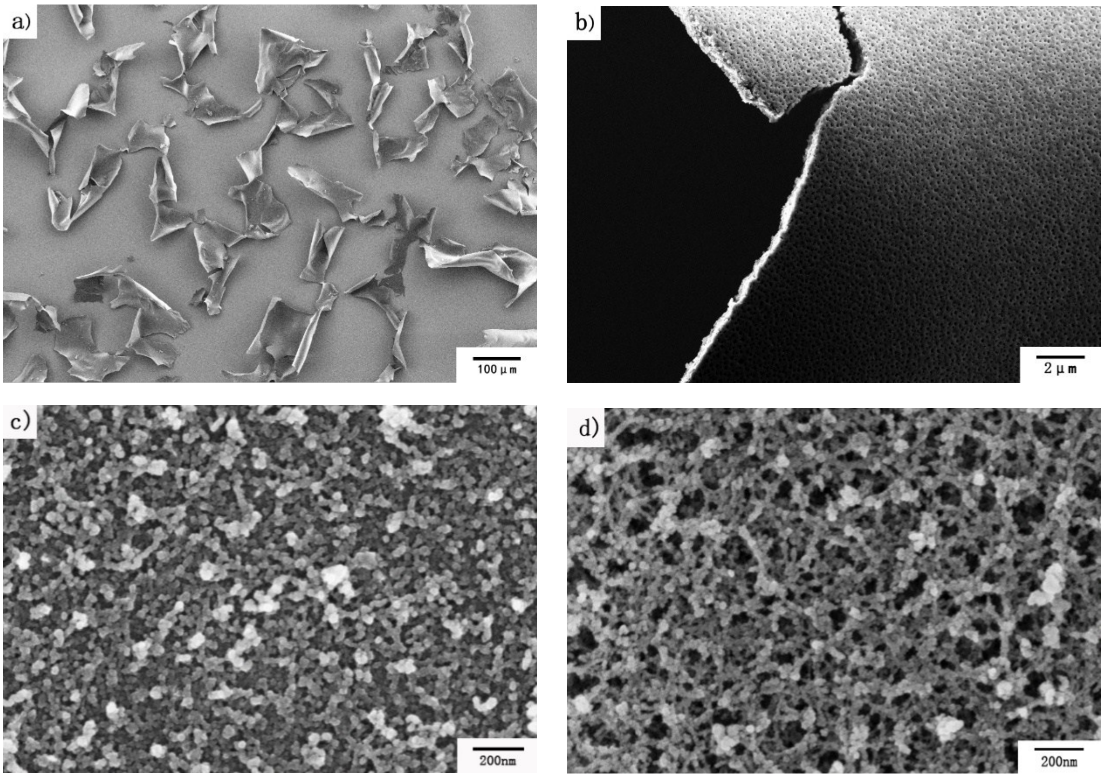

Figure. S2 a) Top view of an unmethylated silica gel film shows the importance of surface modification. b) Side view of a cracked silica gel film shows the importance of surface modification. SEM micrographs of silica aerogel films modified by TMCS at (c) 12 h, (d) 24 h

As shown in Figure. S2 a), the unsilylated silica gel film is curled and ruptured extensively due to internal stress, failing to form a uniform film on the surface of the substrate. From Figure.S2 b), it is clear that a large number of holes still remain in the cross-section, which is caused by the collapse of the internal structure of the silica aerogel film. Therefore, we consider it necessary to methylate the silica aerogel film before it is dried at ambient pressure.

The silylation of the wet gel film is mainly to eliminate the effect of solvent evaporation of the wet gel film on its internal network during the drying process. When the dried silica gel film is placed in the oven for further drying, the methyl groups inside the dried silica gel film are no longer necessary. By annealing at 450 ° C, the methyl groups on the inner surface of the silica aerogel film will be converted to hydroxyl groups, and the internal structure of the silica aerogel film will be further optimized（C. Folgar, D. Folz, C. Suchicital and D. Clark, *J. Non-Cryst. Solids*, 2007, 353, 1483-1490.）.

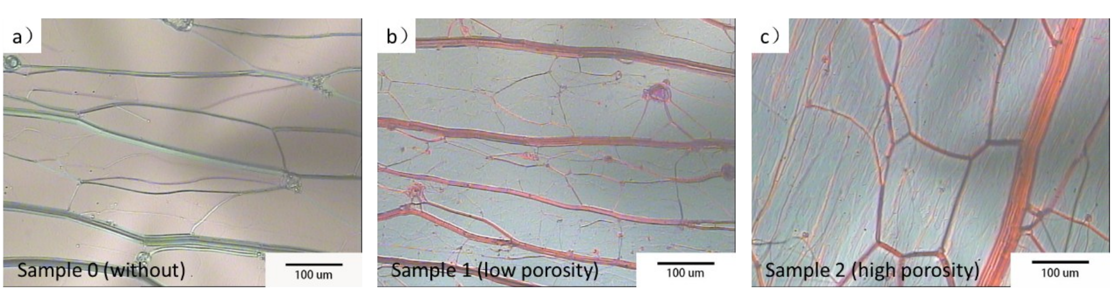

Figure. S3 a, b, c) POM images of sample 0, 1 and 2 show the effect of silica aerogel film on the ordered arrangement of cholesteric liquid crystal molecules.

As shown in Figure.S3, the sample 1 and 2 show a planar texture as well as the sample 0.

However, there are still some differences in the texture of the samples. It can be clearly seen that there are some defects in the texture of the sample with silica aerogel film, and these defects in the texture of sample 2 are more than that of sample 1. This observation can be attributed to the ordered arrangement of N*-LC molecules was changed by the porous and distinct three-dimensional network structure of silica aerogel film. Compared to the silica aerogel film with lower porosity, the aerogels with higher porosity have larger pore sizes and a more pronounced effect on the ordered arrangement of N*-LC molecules. These POM images also illustrate that the nanostructure of silica aerogel film can help to broaden the reflection bandwidth of N*-LC.

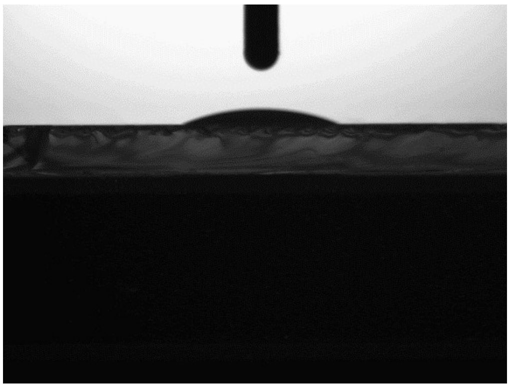

Figure. S4 Contact angle measurements of a 2 μL N*-LC droplet on silica aerogel film.

The wettability between the two materials can be expected by Young's method: $\gamma_{LV}\cos\theta=\gamma_{sv}-\gamma_{sL}$. Here, γ_{LV}, γ_{sv}, γ_{sL}, are the interface tension of the liquid-air, solid-gas, solid-liquid. θ is the contact angle (CA). When θ is less than 90 °, it can be considered that the surface of the two materials is wettable. Normally, the assembly of the liquid crystal cell is carried out in a vacuum chamber and the inside of the cell is vacuumed. Therefore, the mixture of N*-LC can be poured into the porous volume of silica aerogel film under the action of the capillary force. Meanwhile, as shown in Figure. S4, the CA of the N*-LC on the pore wall is only 23.5 °. The silica aerogel film exhibited high wettability with a mixture of N*-LC. Hence, it is believed that the N*-LC molecules insert into the porous volume of silica film.