Supporting Information

Mesoporous Protein Thin Films for Molecule Delivery

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1. TEM images

These TEM images clear show that the nanofibrous structures were disappeared after removing the nanostrands by HCl. However, 2-3 nm channels were not clearly seen in the thick part (Figure S1 b-c). This might be due to the small diameter of the channels as well as the low contrast, when the channels embedded into the thick protein matrix. Then a much thinner piece was investigated by TEM as shown in Figure S 1d. The smaller wrinkles might be the channels derived from the nanostrands. Anyway, the SEM image in Figure 1d should be enough to show the mesoporous channel structures (see main text).

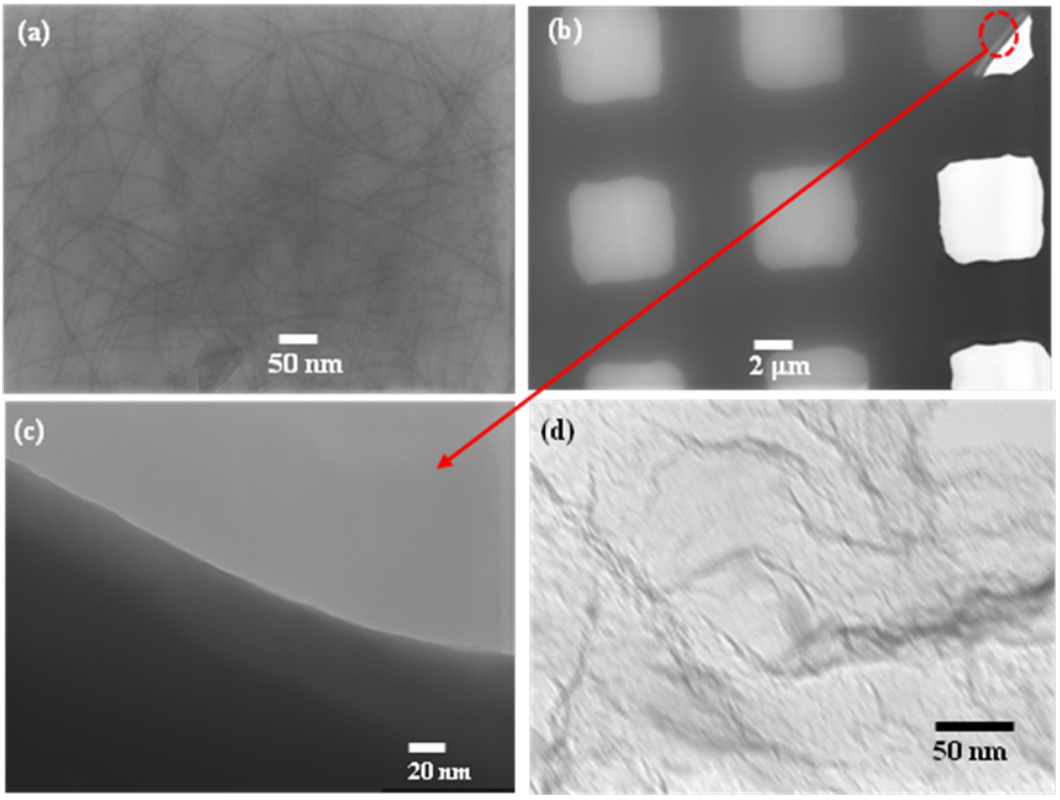

Figure S1 TEM images of the films (a) before and (b)-(d) after removing away nanostrands. The TEM image of (d) was recorded from a very thin piece of the protein film after removing nanostrands prepared by grinding it in ethanol.

2. Non-porous protein films

The non-porous protein films without nanostrands were prepared through the following process: First, a copper hydroxide nanostrands filter cake with thickness of 120 nm was prepared by filtering 10 ml copper hydroxide nanostrands solution on a porous polycarbonate membrane surface with pore size of 200 nm and effective diameter of 3.2 cm. Then 10 ml 0.0285 mg/ml apoferritin was filtered on the nanostrands layer surface. Apoferritin diameter is about 12 nm. The down filtrate was collected. The Uv-vis spectrum recorded from this filtrate confirmed that all the apoferritin were rejected by the nanostrands layer. This is consistent with our previous reported that 10 nm gold nanoparticle could be completely rejected by nanostrands layer. (*J. Mater. Chem. 2011. 21, 1684-1688*). The protein filter cake was cross-linked by filtering 5 ml, 5 wt% glutaraldehyde solutions for 10 minutes. After immersing the PC membranes with nanostrands layer and protein film into 10 ml, 10 mM HCl solution for one hour, the pure free-standing protein film was obtained, named as non-porous protein film.

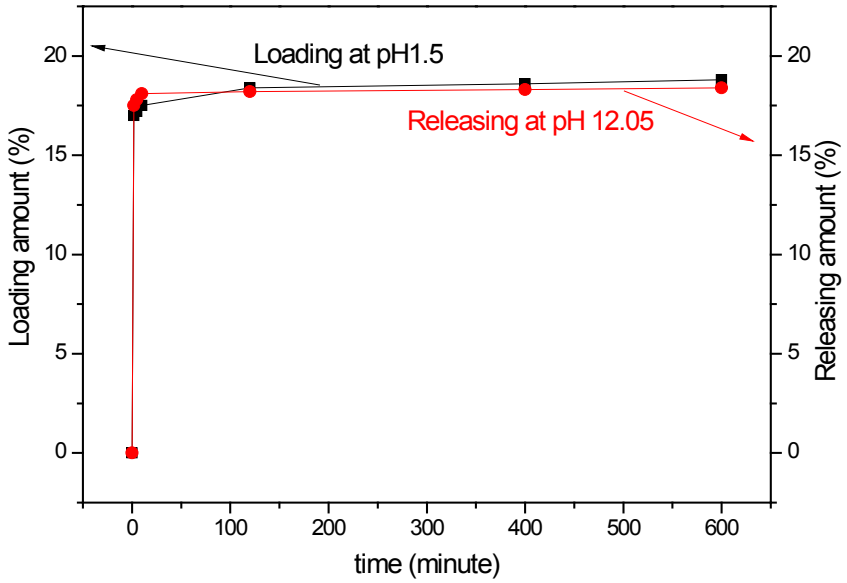

Figure S2 *The loading and releasing performance of DY by a non-porous protein film synthesized without nanostrands as channel templates.*

The loading and releasing of DY molecules were performed by using the prepared non-porous protein film at 10 ml, pH 1.5, 10 mM DY, and 10 ml, pH 12.05 pure water, respectively. Since these two pH values are the fast loading and releasing pH For Dy by using the protein film prepared with nanostrand as channel template. The results, Figure S2, show that the non-porous protein film loading capacity of DY is about 19% within 10 hours. Within 2 minutes, 17 % DY molecules were loaded. After that the loading process was slower and slower. The releasing process is also very quick. 17.5% DY molecules were released within 2 minutes. The remain 1.5 % was released very slowly. About 0.7% was still not released after 10 hours. All the results indicate that most of the DY were loaded on the most-out surface of the non-porous protein film. The loading capacity within 10 hours was 20% as that loaded by

the protein films prepared with nanostrands as channel templates. The reason is that, at the initial stage, much more DY molecules were immediately loaded on the non-porous protein film surface by electrostatic interaction. After that, the DY molecules were very hard to deep into this protein film matrix, since not so many channels existed there. Based on these, it could conclude that the mesoporous channels generated by the nanostrands are responsible for the high delivery performance of the protein film prepared by using nanostrands as channel template, other than that derived from the nature of protein or protein networks.