Hierarchical porous carbon nanofibrous membranes with enhanced shape memory property for effective adsorption of proteins

Gang Fan a†, Jianlong Ge b†, Hak-Yong Kim c, Bin Ding a,b,*

Salem S. Al-Deyab d,* Mohamed El-Newehy d,e, Jianyong Yu b

a State Key Laboratory for Modification of Chemical Fibers and Polymer Materials, College of Materials Science and Engineering, Donghua University, Shanghai, 201620, China.

b Key Laboratory of Textile Science & Technology, Ministry of Education, College of Textiles, Donghua University, Shanghai 201620, China.

c Department of BIN Fusion Technology, Chonbuk National University, Jeonju 561-756, Republic of Korea.

d Petrochemical Research Chair, Department of Chemistry, College of Science, King Saud University, Riyadh 11451, Saudi Arabia.

e Department of Chemistry, Faculty of Science, Tanta University, Tanta 31527, Egypt.

† These authors contributed equally to this work.
Support information

Calculation of fractal dimension

The fractal dimension (D) was calculated by following FHH equation:

\[ \ln \left( \frac{V}{V_{\text{mono}}} \right) = A \ln \left( \frac{\ln P_0}{P} \right) + \text{constant} \]

where \( V \) is the amount of N\(_2\) adsorbed at each equilibrium pressure, \( P \); \( V_{\text{mono}} \) is the adsorbed amount of monolayer coverage; and \( P_0 \) is the saturation pressure. By which a plot of \( \ln \left( \frac{V}{V_{\text{mono}}} \right) \) versus \( \ln \left( \frac{\ln P_0}{P} \right) \) shows a linear trend could be reconstructed, and the slope \( A \) could be used to calculate \( D \) utilizing the expression: \( A = D - 3 \), which was according to the dominant forces of liquid-gas surface tension at high coverage.

Fig. S1 SEM images of (a) pristine CNF membrane showing the cracking, and (b) SiO\(_2@CNF-20\) membrane with intact structure under deformation.
Fig. S2 Tensile curves of CNF membranes derived from precursor fibers with different SiO$_2$ nanoparticles contents.

Fig. S3 In-situ SEM images of SiO$_2$@CNF-20 membrane showing the robust mechanical stability of single fiber under different deformations.
Fig. S4 BSA adsorption capacity of CNFs membranes derived from precursor fibers with different SiO$_2$ nanoparticles contents.