Supplementary Information for

Flexible inorganic nanofibrous membranes with hierarchical porosity for efficient water purification

Qiang Wen,[a] Jiancheng Di,[a] Yong Zhao,[b] Yang Wang,[a] Lei Jiang[b] and Jihong Yu[*a]

[a] *State Key Laboratory of Inorganic Synthesis and Preparative Chemistry, Jilin University, Qianjin Street 2699, Changchun 130012, China P.R. Fax: +86-431-8516-8608; Tel: +86-431-8516-8608; E-mail: jihong@jlu.edu.cn*

[b] *School of Chemistry and Environment, Beihang University, Beijing100191, China P.R*

Experimental section

The spinnable precursor containing silica and titania sources together with PEO and a mesopore generating (CTAB) agent in ethanol and HCl aqueous solution was prepared. The concentration of CTAB in the precursor solution influenced the surface area of STPNMs, meanwhile, the ionized CTAB molecules would increase the conductivity of the precursor solution which might lead to the instability of electrospinning process. Herein, the CTAB/TEOS molar ratio was fixed to 0.26. The spinnability of solution was also dependent on the content of PEO. With the decrease of PEO, beads appeared on the fibers, while when more PEO was added, ribbons were obtained. So, the content of PEO in the precursor solution was fixed to ca. 0.05g / mL. The optimum molar ratio for the preparation of STPNMs was 1.0 TEOS: x $TiCl_3$: 0.26 CTAB: 0.03 HCl: 3.99 EtOH: (6.98-5x) H_2O: 1.0×10^{-5} PEO, where x = 0.042, 0.056, 0.083, 0.167, respectively. The viscous solution was spun with a flow rate of 1 mL h^{-1} and the product was collected on a rolling collector. After the removal of organics by calcination, inorganic nanofibrous membranes with hierarchical porosity were obtained.

Characterizations

SEM images were measured with JEOL FE-SEM 6700F microscopy and JSM-6510 microscopy. TEM images were recorded on JEOL JEM-2100F. Water contact angles (CAs) were measured on a Dataphysics OCA20 contact-angle system at ambient temperature and each was obtained with water droplet of ca. 3 μL by measuring more than five different positions on the same sample. The small-angle X-ray diffraction

(XRD) patterns were recorded on a Rigaku D/MAX 2500 diffractometer with CuKα radiation (λ = 1.5418Å). Nitrogen adsorption-desorption measurements were carried out at -196 ºC on ASAP2020. UV-vis spectra were obtained on a Hitachi U-4100 UV-vis spectrophotometer. Fourier transform infrared (FT-IR) spectra were recorded from 400 to 4000 cm^{-1} on a Nicolet Impact 410 FTIR spectrometer by using KBr pellets. Zeta-potential values were recorded using a Zeta Sizer Nano-ZS90.

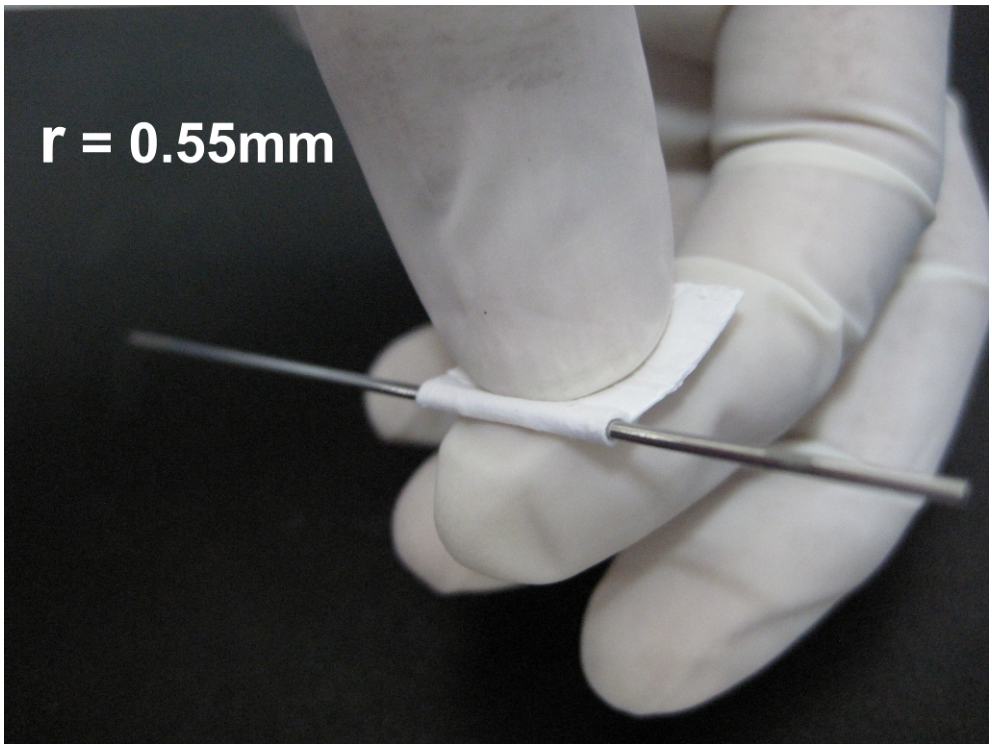

Fig. S1 STPNM-6 curved to 0.55 mm radius of curvature.

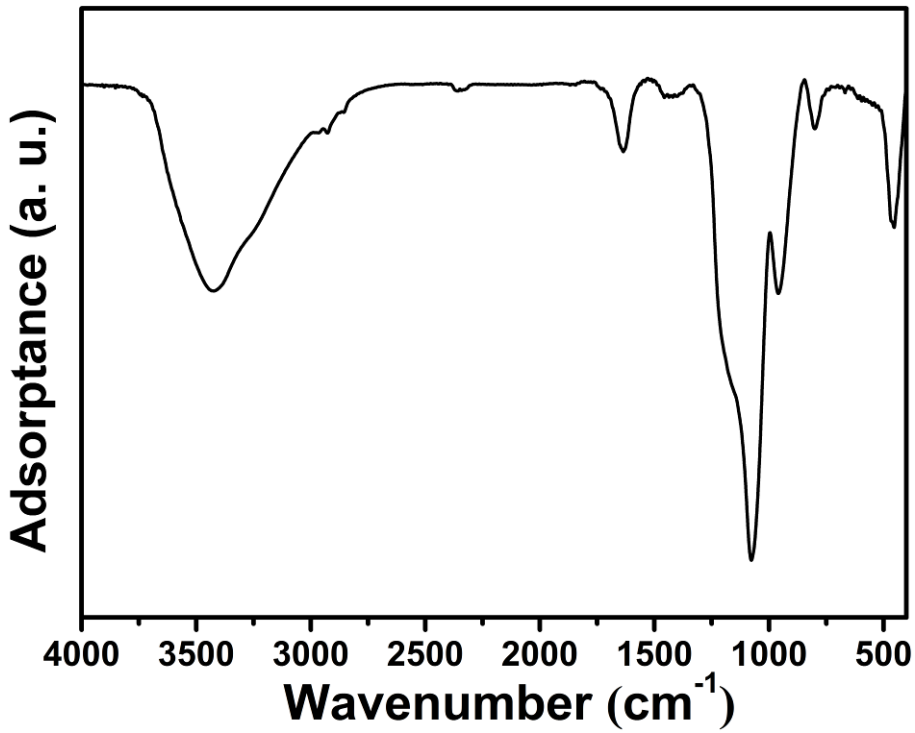

Fig. S2 FT-IR spectrum of STPNM-6. The appearance of absorption bonds around 1100, 800, 460 cm^{-1} corresponds to Si–O–Si groups.[1] The peak around 935 cm^{-1} is attributed to the Ti–O–Si bonds and the band at 400-600 cm^{-1} indicates the presence of the Ti–O–Ti bonds.[2] The wide peak bond at 3424 cm^{-1} proves the presence of –OH.[3, 4]

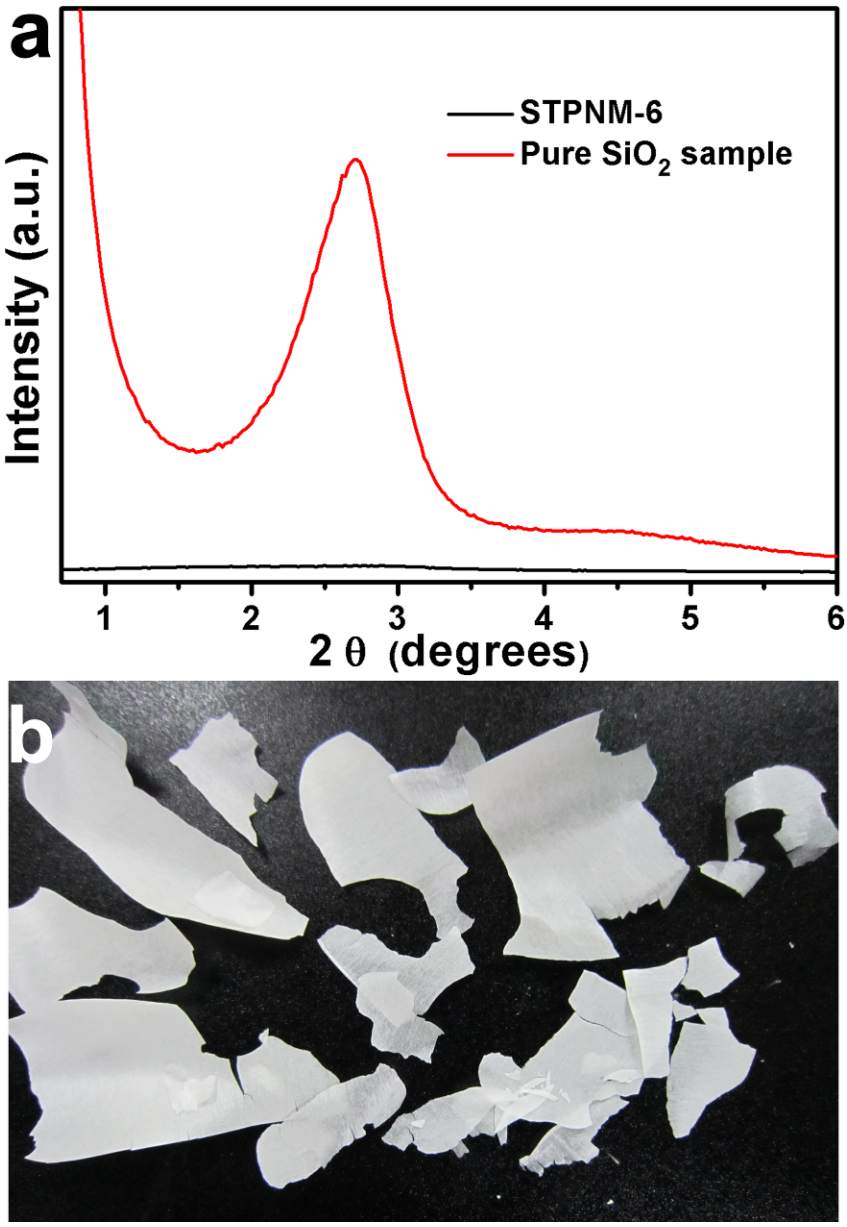

Fig. S3 (a) Small-angle XRD patterns of pure silica nanofibrous membrane (black) and STPNM-6 (red), respectively. (b) Optical images of pure silica nanofibrous membrane after calcination.

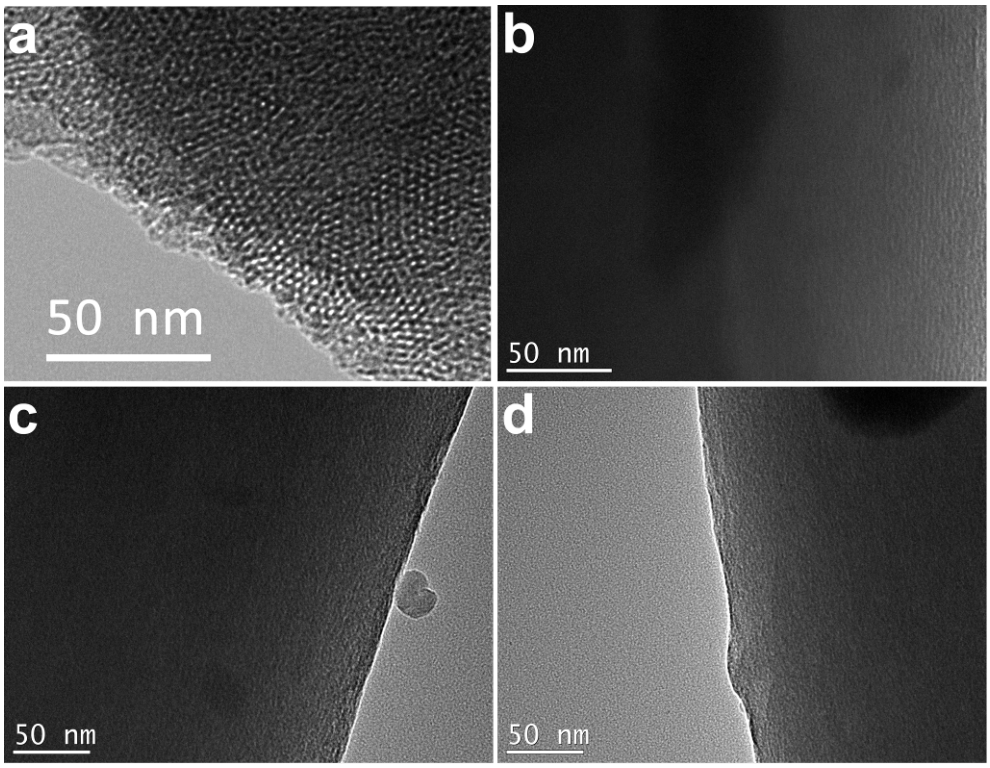

Fig. S4 TEM images of pure silica nanofibrous membrane (a) and STPNMs with Si/Ti molar ratio of 24, 18 and 12 (b-d), respectively.

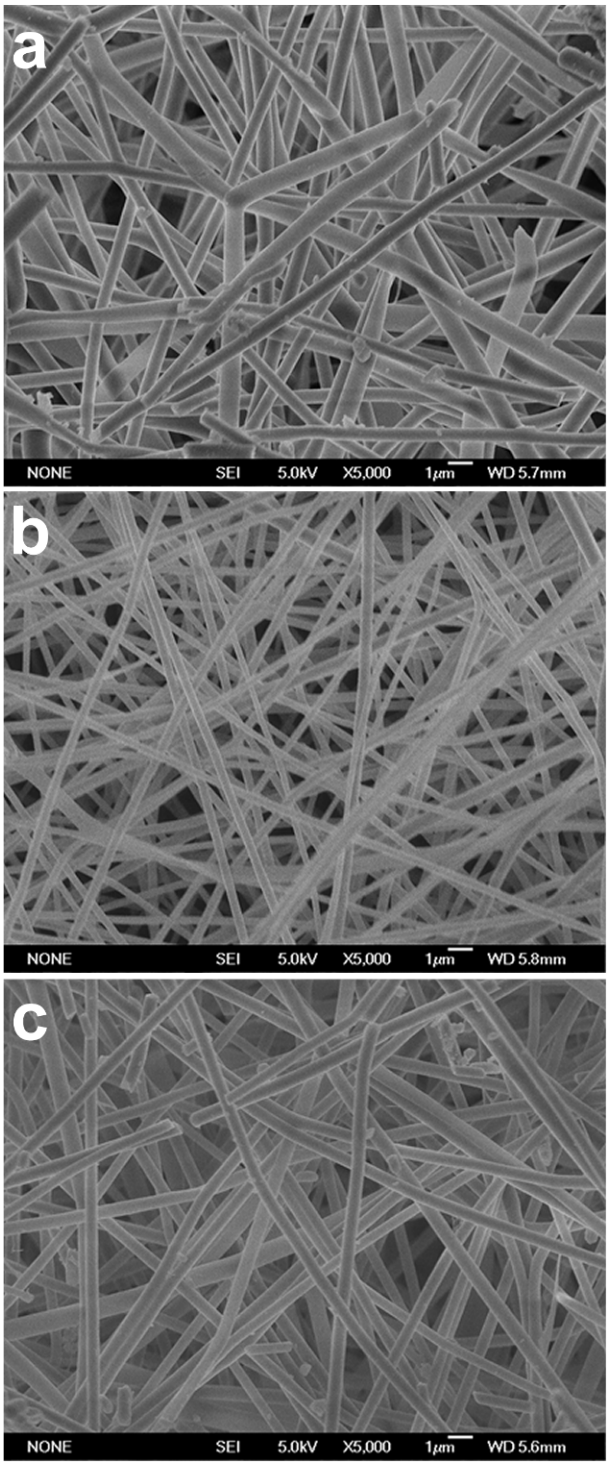

Fig. S5 SEM images of STPNMs with Si/Ti molar ratio of 24, 18 and 12 (a-c), respectively.

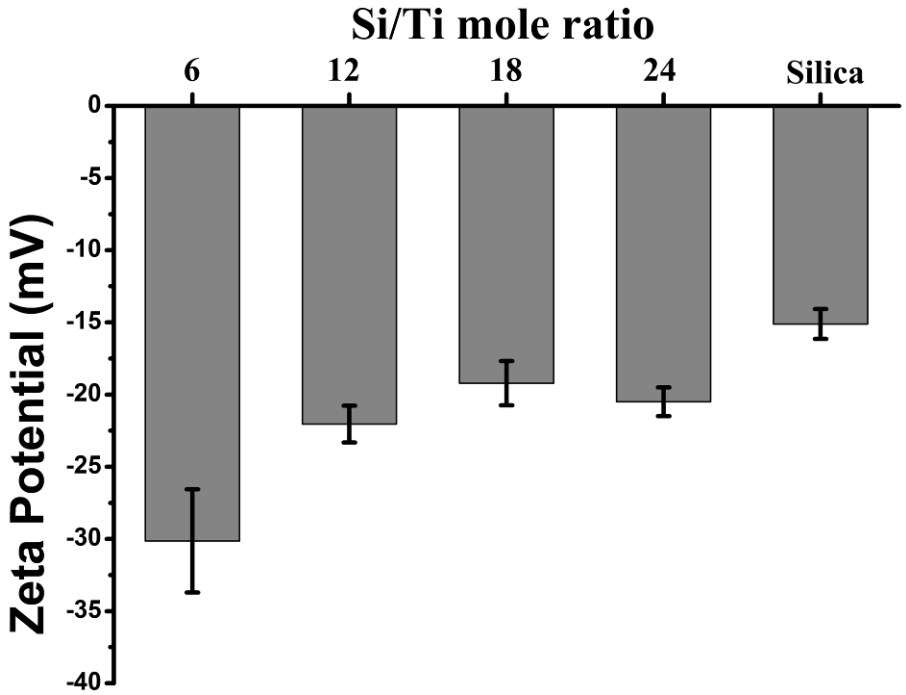

Fig. S6 Zeta potential vs. Si/Ti molar ratio.

References

1. B. Ding, H. Kim, C. Kim, M. Khil and S. Park, *Nanotechnology*, 2003, **14**, 532-537.

2. S. K. Samantaray and K. Parida, *Appl. Catal., A*, 2001, **220**, 9-20.

3. S. Kondo, H. Yamauchi, Y. Kajiyama and T. Ishikawa, *J. Chem. Soc., Faraday Trans. I*, 1984, **80**, 2033-2038.

4. R. Jin, Z. Wu, Y. Liu, B. Jiang and H. Wang, *J. Hazard. Mater.*, 2009, **161**, 42-48.