# Carbon nanotube sponge filters for trapping nanoparticles and dye molecules from water

Hongbian Li,[a] Xuchun Gui,[b] Luhui Zhang,[a] Shanshan Wang,[a] Chunyan Ji,[a] Jinquan Wei,[b] Kunlin Wang, [b] Hongwei Zhu,[b] Dehai Wu[b] and Anyuan Cao*[a]

## Supplementary Information:

Fig. S1. Filtration of neutral and positively charged $TiO_2$ nanoparticles.

Fig. S2. Comparison of sponge and buckypaper filters.

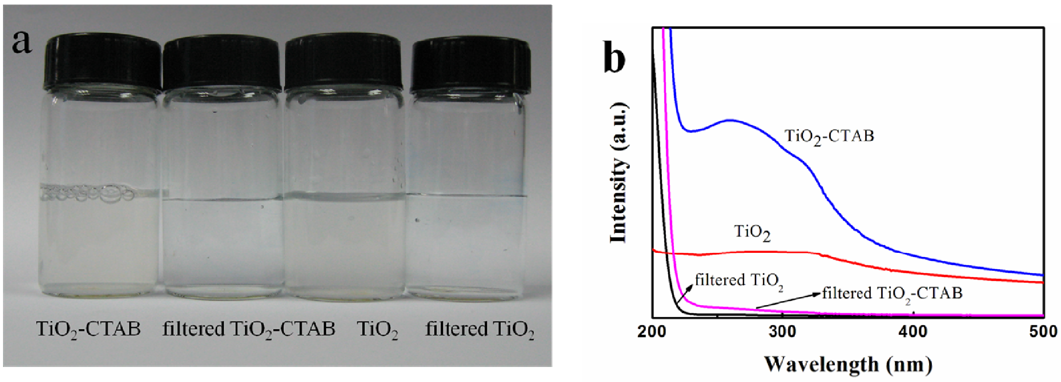


Fig. S1. Filtration of neutral and positively charged $TiO_2$ nanoparticles. (a) Pictures of $TiO_2$-CTAB (positively charged), $TiO_2$-CTAB after filtration, $TiO_2$ (neutral) and filtered $TiO_2$ colloids (from left to right vials). (b) UV-Vis spectra of the $TiO_2$-CTAB and $TiO_2$ colloids before and after filtration, showing effective removal of both neutral and positive $TiO_2$ nanoparticles by CNT sponge filters.

**Synthesis of neutral and positively charged $TiO_2$ colloids.** $TiO_2$ nanoparticles were synthesized according to literature[1] using a hydrothermal method. The 10~20 nm diameter nanoparticles were dispersed in $H_2O$ to 0.5 mM. These nanoparticles do not bear negative or positive charges because there are no organic molecules grafted on the particle surface. To make positively charged nanoparticles, we added 0.5 mM cationic surfactant CTAB to the $TiO_2$ colloid according to literature[2]. Filtration and UV-Vis measurement were carried out in the same procedure as Au and CdS colloids described in the text. We note that stronger absorption peak (240~330 nm) of $TiO_2$-CTAB than $TiO_2$ is due to better dispersion of $TiO_2$ nanoparticles grafted by CTAB.

**Literature 1.** J. J. Wu, X. J. Lv, L. L. Zhang, Y. J. Xia, F. Q. Huang and F. F. Xu, *J. Alloys Compd.*, **2010**, *496*, 234.

**Literature 2.** Y. C. Qu, W. X. Wang, L. Q. Jing, S. Song, X. Shi, L. P. Xue and H.

G. Fu, *Appl. Surf. Sci.*, **2010**, *257*,151.

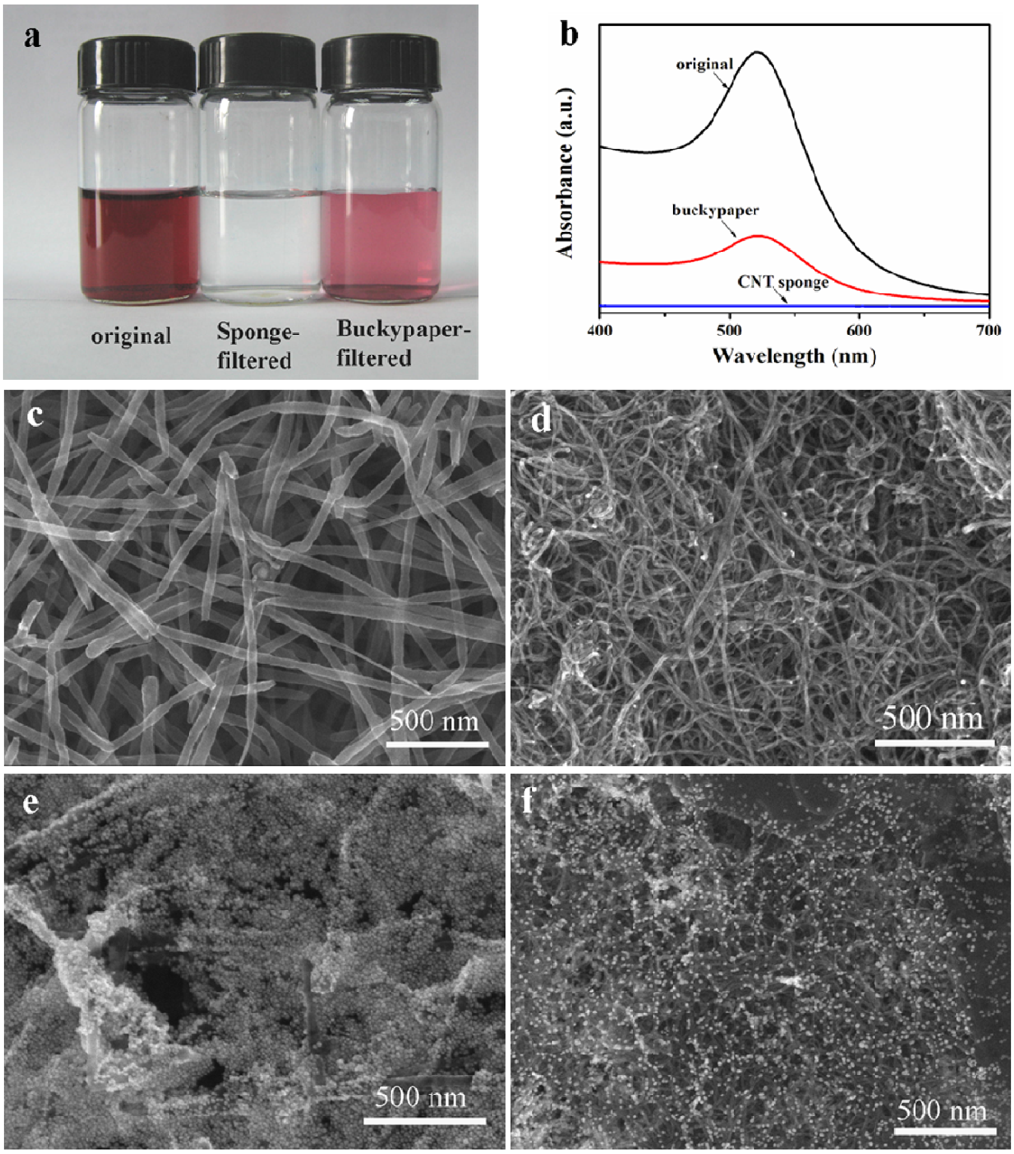


Fig. S2. Comparison of sponge and buckypaper filters. Photograph (a) and UV-Vis spectra (b) of the Au colloid before and after filtration by the sponge and buckypaper filters respectively. SEM images of the CNT sponge (c) and buckypaper (d) before filtration. SEM images of Au NPs blocked on the sponge (e) and buckypaper surface (f) after filtration.

**Comparison of sponge and buckypaper filters**

The thickness of buckypaper (on the order of 100 nm) was controlled to allow water pass through under the same pressure in our sponge apparatus. The sponge and buckypaper was used to filter a water suspension of 25 nm Au nanoparticles (0.5 mM), respectively, under the same condition. We can see clear difference in the color of water coming out from the two filters, indicating that the sponge is much more effective in removing nanoparticles than the buckypaper (Fig. S2a). This observation is supported by the UV-Visible spectra, in which the characteristic peak of Au nanoparticles at 525 nm completely disappeared in water filtered by the sponge, and the peak still exists in water filtered by the buckypaper (Fig. S2b). SEM images on the surface of these two samples show that both have a porous structure, although the CNT diameter and pore size is different (Fig. S2c, 2d). It is interesting that the sponge with larger pore size (>80 nm) works better in filtering small nanoparticles than the buckypaper with smaller pore size (<40 nm). SEM images after filtration also show that more nanoparticles are blocked on the surface of the sponge than the buckypaper (Fig. S2e, 2f).