Supporting Information

Polymer Nanotubes toward Gelating Organic Chemicals

Wei Ni, Fuxin Liang,* Jiguang Liu, Xiaozhong Qu, Chengliang Zhang, Jiaoli Li, Qian Wang, and Zhenzhong Yang*

State Key Laboratory of Polymer Physics and Chemistry
Institute of Chemistry, Chinese Academy of Sciences
Beijing 100190 (China)
Fax: (+86) 10-6255-9373
E-mail: liangfuxin@iccas.ac.cn; yangzz@iccas.ac.cn
Homepage: http://yangzz.iccas.ac.cn

Content

1. Synthesis method

2. Characterization

3. Figure S1–S11

***Synthesis of Pristine Crosslinked Polymer Nanotubes*:** For a typical example, at room temperature e.g. 25 °C, a given amount (for example 150 mg) of BFEE (boron trifluoride diethyl etherate complex $BF_3{\cdot}O(Et)_2$) was immediately added into 150 ml of cyclohexane containing 1–8 wt.-% of monomer DVB under stirring to initiate the cationic polymerization. In order to monitor growth of the nanotubes at different stage, 10 g of ethanol was added to terminate the polymerization. The samples were filtered and washed with ethanol to remove residual initiator and monomer. After residual ethanol was evaporated, the nanotube powder was obtained.

***Characterization*:** JEOL JSM-6700F scanning electron microscope (SEM) and JEOL JEM-1011 transmission electron microscope (TEM) were mainly used for morphological characterization of the nanotubes and their macroscopic forms. The samples were sputtered with platinum for SEM characterization. Contact angle of 5 ul of water droplets was measured on Dataphysics OCA20 at ambient temperature. The size and distribution of the initiator droplets dispersed in cyclohexane was measured with size analyzer by dynamic light scattering (Malvern Zetasizer Nano ZS).

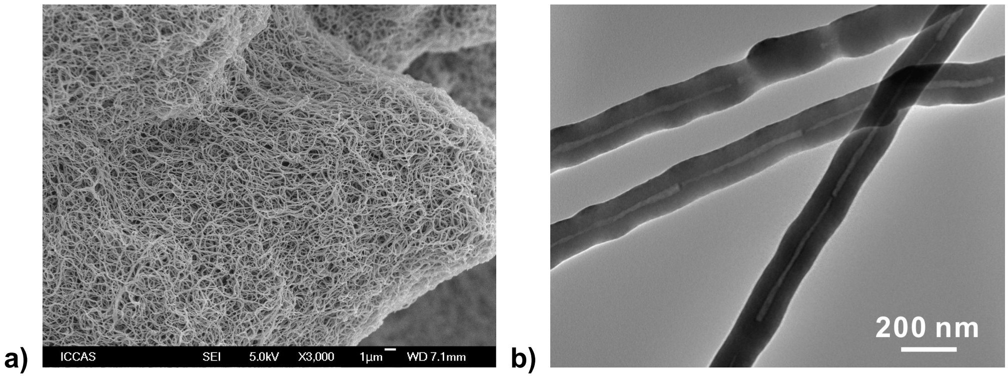


Figure S1. PDVB nanofibers with a rather narrow interior compartment prepared at 0 °C. Monomer concentration is 2 wt.-%, and initiator concentration 0.12 wt.-%.

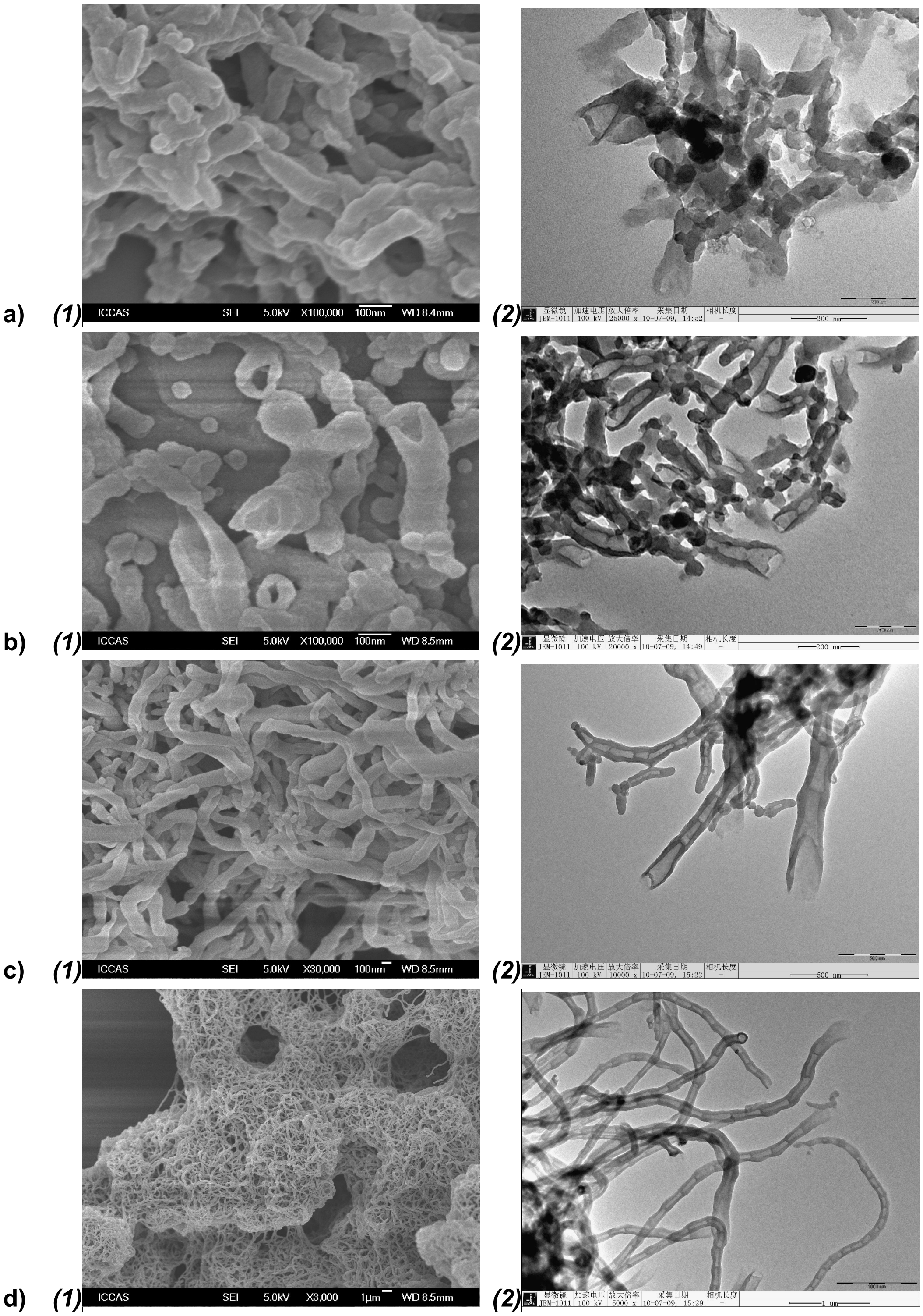


Figure S2. Morphological evolution with polymerization time (seconds). a) 10; b) 30; c) 60 and d) 120. Monomer DVB concentration is fixed at 1 wt.-%.

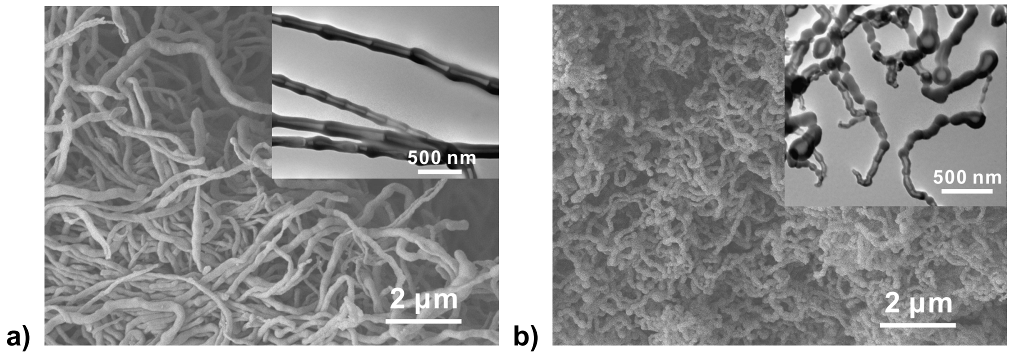


Figure S3. Morphology dependence of the PDVB nanotubes on monomer concentration. a) 1 wt.-% and b) 8 wt.-%. The initiator concentration is fixed at 0.12 wt.-%.

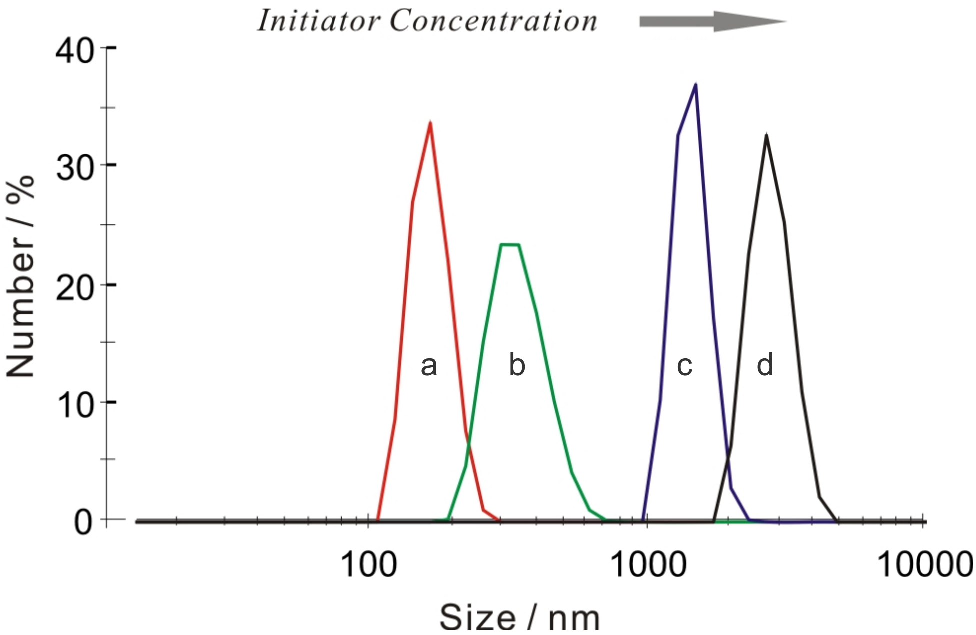


Figure S4. Size distribution of BFEE droplets dispersed in immiscible cyclohexane at varied concentration via DLS. a–d) 0.12 wt.-%; 0.24 wt.-%; 0.48 wt.-% and 0.96 wt.-%.

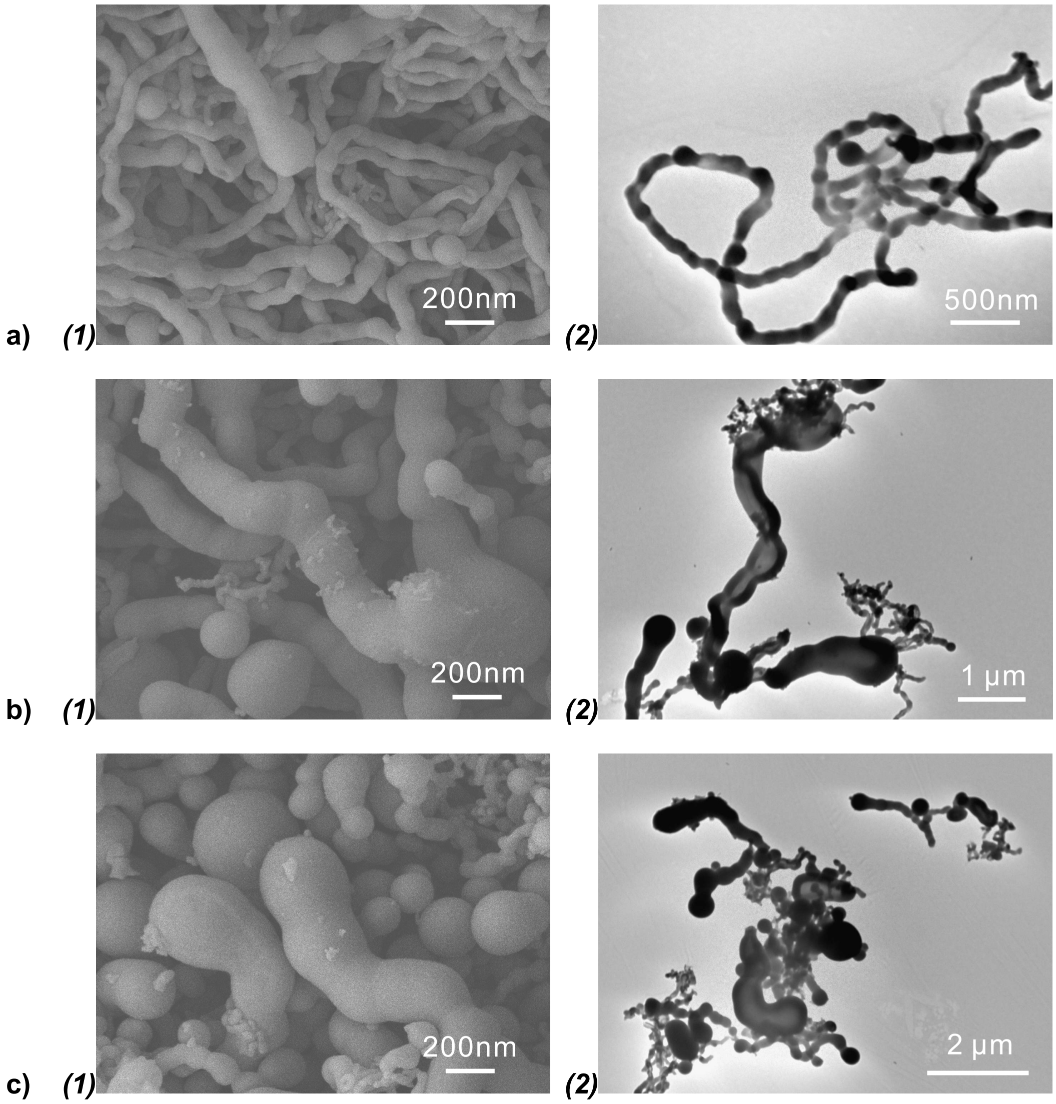


Figure S5. Morphology dependence of PDVB on the initiator concentration. a) 0.24 wt.-%; b) 0.48 wt.-% and c) 0.96 wt.-%. The monomer concentration is fixed at 2 wt.-%.

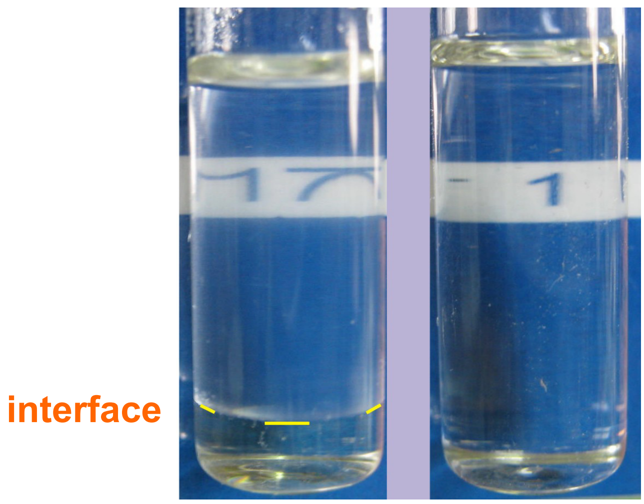
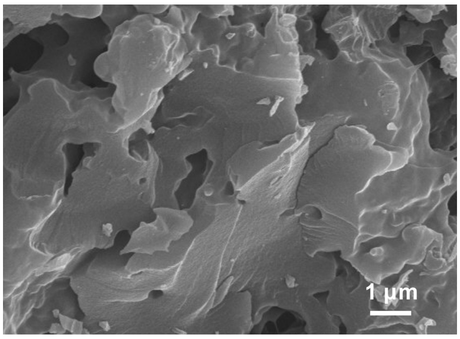


Figure S6. BFEE dispersed in incompatible cyclohexane (left), and dissolved in compatible dichloromethane (right).

a) 

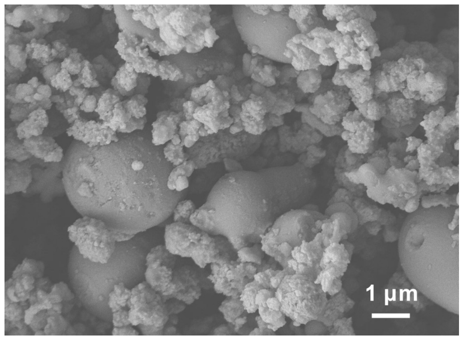
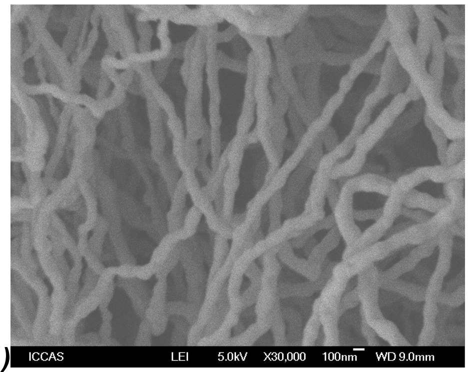
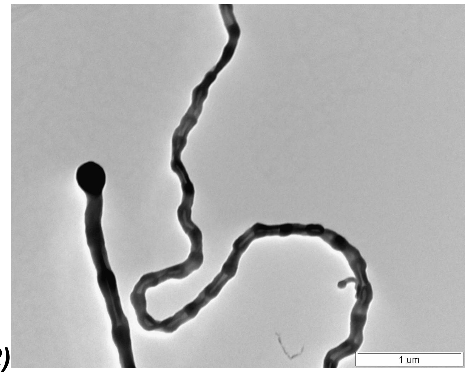
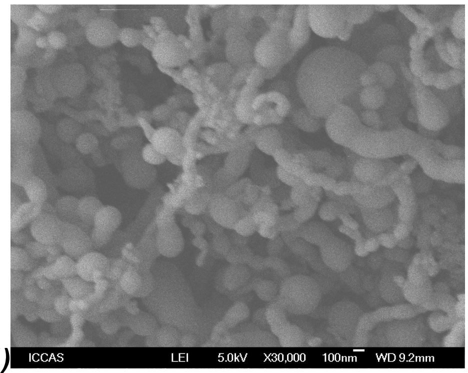
b) 

Figure S7. Morphology dependence of PDVB on dichloromethane/cyclohexane ratio. a) dichloromethane (20 ml), and b) 1:3 (5 ml/15 ml). The monomer concentration is fixed at 4 wt.-%.

a) *(1)* 

(2) 

b) *(1)* 

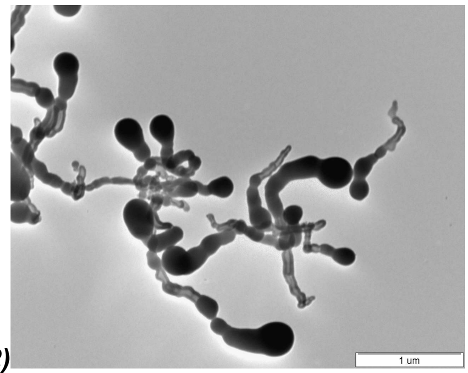
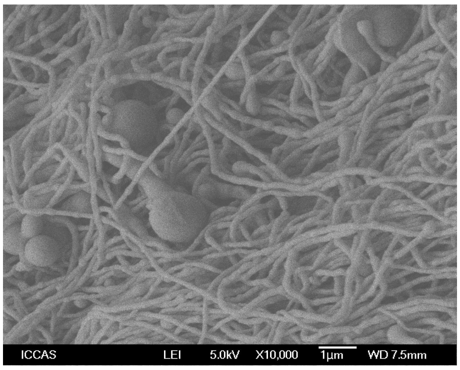
(2) 

Figure S8. Morphology dependence of Poly(DVB-St) on DVB/styrene ratio. a) 8:1 and b) 2:1. The monomer concentration is fixed at 4 wt.-%.

a) 

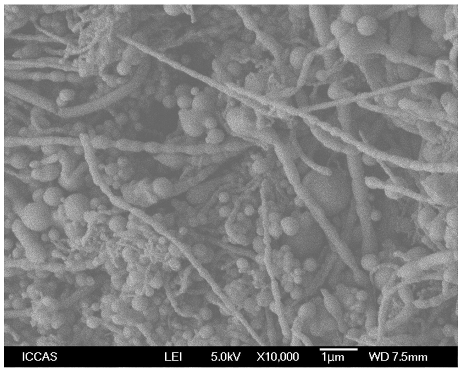
b) 

Figure S9. Morphology dependence of Poly(DVB-*co*-VBC) on monomer DVB/VBC ratio. a) 1:1 and b) 1:4. Monomer concentration is fixed at 4 wt.-%.

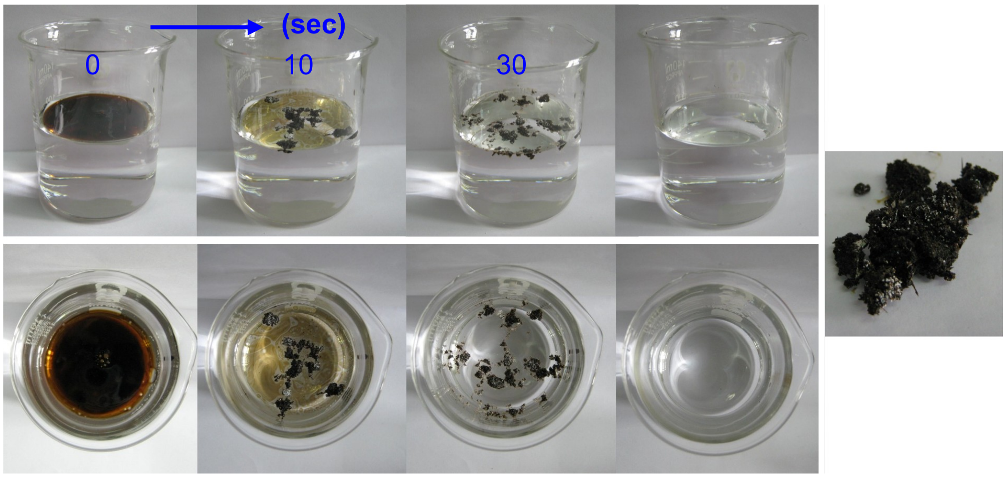
a) 
b) 

c) 

d) Gelation capability for different chemicals with the PDVB nanotubes

chemicals	cyclohexane	toluene	carbon tetrachloride	dimethyl formamide	ethanol	water
density (g/ml)	0.78	0.87	1.59	0.95	0.79	**1.00**
absorption (g/g) (ml/g)	**20 (26)**	**20 (23)**	**35 (22)**	**19 (20)**	**15 (19)**	**~0 (~0)**

Figure S10. a, b) Macroscopic appearance of the PDVB nanotubes dispersed in the solvent and their powder; c) the sponge with chemicals absorbed, and after the chemicals are volatile; d) gelation capability of the PDVB nanotubes for different chemicals.

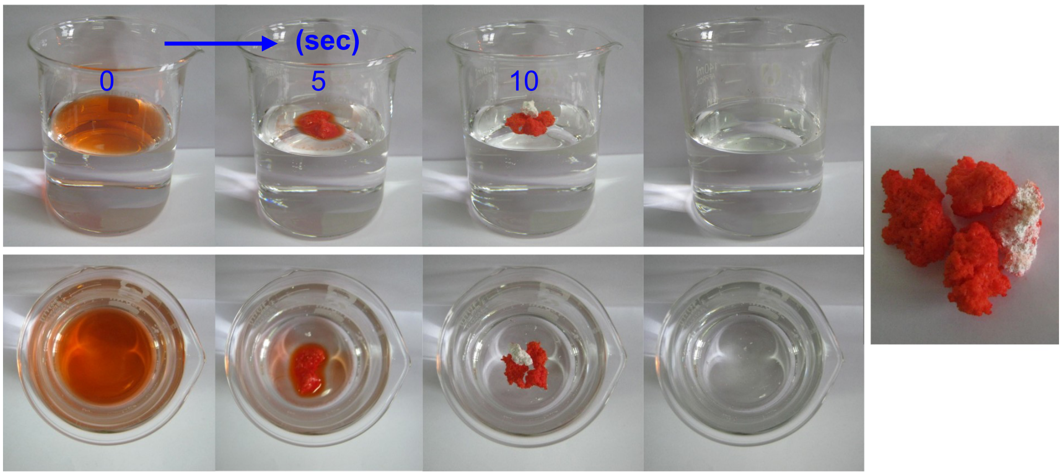


a)

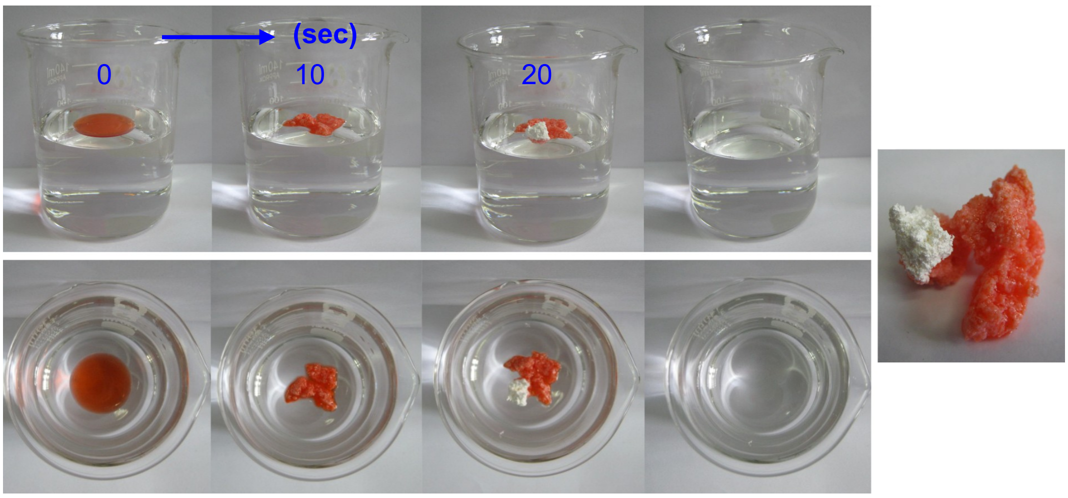
b)

c)

d)



e)



f)

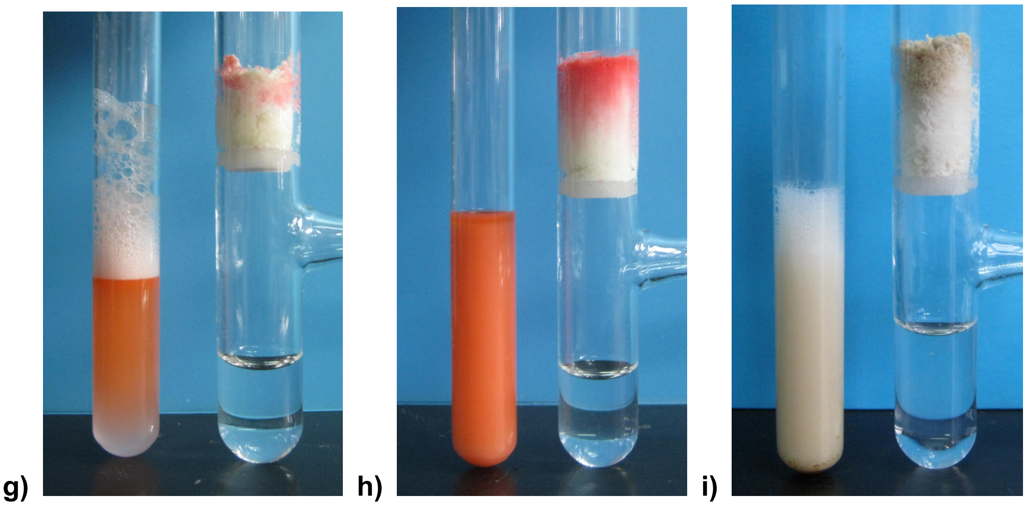


Figure S11. a) Gelation viscose crude oil with PDVB nanotube powder on water phase; b-d) PDVB nanotubes partially saturated with crude oil, completely saturated, and after oil is squeezed; e, f) gelation hexane and less viscose liquid paraffin; g–i) cyclohexane-in-water (1:2) emulsions stabilized with anionic sodium dodecyl sulfate and with non-ionic Span-80 respectively, and pesticide (phoxim) emulsion. All the red oil phases are dyed with Sudan III.