

**Support information**

**A facile approach to obtain super-hydrophobicity for cotton fiber  
fabrics**

Zhengrong Li <sup>a</sup>, Junxin Wu <sup>a</sup>, Yidi Wang <sup>b</sup>, Yuxin Li <sup>a</sup>, Gang Huang <sup>a</sup>, Bin Fei <sup>b,\*</sup>, Zhixiong Xu <sup>c</sup>,  
Yong Zhang <sup>c</sup>, Yangling Li <sup>a,c\*</sup>

<sup>a</sup> School of Textile Materials and Engineering, Wuyi University, Jiangmen, 529020, China

<sup>b</sup> Nano Center, Institute of Textiles & Clothing, Hong Kong Polytechnic University, Hong Kong,  
China

<sup>c</sup> CCOBATO (Dongguan) technology., Ltd, Dongguan, 523000, China

\* Email: [yangling\\_li@163.com](mailto:yangling_li@163.com)

\* Email: [Bin.fei@polyu.edu.hk](mailto:Bin.fei@polyu.edu.hk)

**1. Materials**

N-isopropylacrylamide (NIPAm), recrystallized by n-hexane, was purchased from Jiangsu Aikang Biomedical Research and Development Co., Ltd (China). Polyethyleneimine (PEI) was bought from Sigma-Aldrich (USA); N, N-methylenebisacrylamide (MBA), was acquired from Shanghai macklin Biochemical Technology Co., Ltd (China). tert-butyl hydroperoxide (TBHP) and Polymethylhydrosiloxane (PMHS) were purchased from Shanghai Meryer Chemical Technology Co., Ltd (China). Emulsifier-1306 was kindly supplied by Guangzhou Qilei Trading Co., Ltd (China). Cotton fabric was used as receive in the lab.

**2. Preparation of the thermo-responsive microgel**

The typical synthesis steps are as follows: 2.40 g NIPAm, 6.40 g MBA (0.5% aqueous solution), 1.20 g PEI, 60 g distilled water were added to the beaker, and the pH of the solution was adjusted to 7-8. Then, the polymerization was carried out in a 100 mL three-port flask under nitrogen environment. After deoxygenation with nitrogen for 60 min, 2.40 g TBHP (0.1 % aqueous solution) was added as an initiator, and the reaction was carried out in a heated oil bath at 250 rpm and 70°C for 6 h. A milky liked microgel solution was obtained.

**Preparation of the Pickering emulsion**

Take Emulsion-37 as example: 25.00 g above prepared microgel solution, 15.00 g PMHS and 10.00 g distilled water were uniformly mixing together under slightly stirring. Then the mixed solution was emulsified for 60 s at 10,000 rpm by high-speed shear homogenizer to get the sample Emulsion-37, where the microgel content was 2.14 wt%.

### **3. Preparation of hydrophobic fabrics**

The typical method is as follow: adding 50.00 g the mentioned Pickering emulsion to 950.00 g distilled water to obtained a working solution. Then, we take two-dip-two-padding method to process the fabrics with rolling rate as 80 %. After that, the finished fabrics was dry at 80°C for 6 min, and then bake at 160°C for 4 min.

### **4. dynamic light scattering**

The particle size and thermo-sensitivity of microgels were characterized through dynamic light scattering: a drop of the synthesized PNIPAm-PEI microgel dispersion was added to a vial containing distilled water, and its particle size and distribution were determined at specific temperatures (25/30/35/40/45 ° C).

### **5. volume phase transition of the microgels**

The volume phase transition of the microgels was measured using a UV-6100 spectrophotometer (Shanghai Yuanxi Instrument Co Ltd.). The microgels were diluted with distilled water to a concentration of 0.01 wt%, heated to different temperatures (25/30/35/40/45°C), and then stabilized for 15 min. The transmittance was measured at

$\lambda_{\text{max}} = 600 \text{ nm}$ .

### **6. FTIR analysis**

Fourier transform-infrared (FT-IR) analysis was examined on a Vector 33 FT-IR spectrometer (Nicolet iS 10, Thermo Fisher Scientific Inc., American) over the wavenumber range of 400 – 4000  $\text{cm}^{-1}$  using the potassium bromide (KBr) compression method.

### **7. SEM**

The morphology of the microgels was characterized via scanning electron microscopy (TESCAN MIRA LMS, Czech) with a 3.00 kV accelerating voltage. The samples for SEM observation are ambient dried and vacuum-sputtered with Au.

### **8. optical microscope**

The morphology and size of the emulsions stabilized with the microgels were characterized using the optical microscope by taking pictures with computer software. The emulsion was diluted with deionized water and dropped on a clean slide.

### **9. Confocal laser scanning microscopy**

Confocal laser scanning microscopy (CLSM) images of emulsions were taken by TCS SP8 (Leica, Wetzlar, Germany). The laser with the wavelength of 561 nm was used to excite Nile red. Before emulsification, the oil phase was dyed with Nile red (0.1 mg/mL).

## 10. water contact angles

The water contact angles (WCAs) were analyzed using the Kuss DSA25E System (Germany) by the pendant drop method at room temperature. The volume of water droplets used was 5  $\mu\text{L}$ . At least five measurements were taken to calculate the average values.



Figure S1. the appearance of PEI-g-PNIPAm microgel.

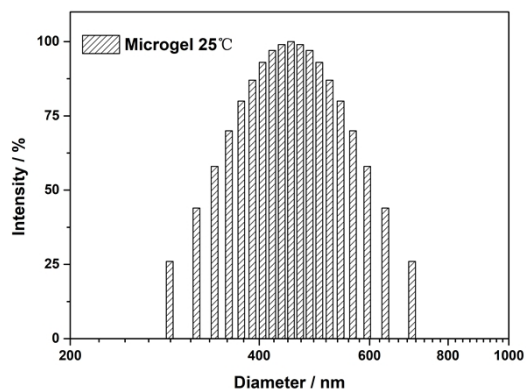


Figure S2. the PEI-g-PNIPAm microgel's size at 25°C.

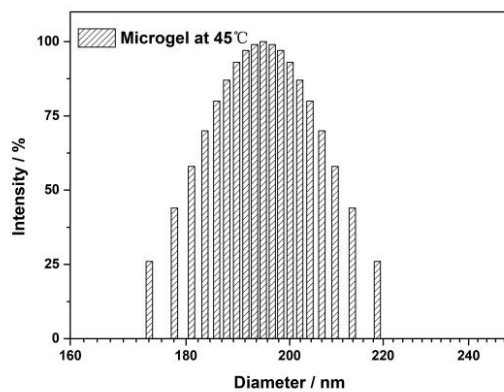


Figure S3. the PEI-g-PNIPAm microgel's size at 45°C.



Figure S4. The stability test of the Pickering emulsion with different PEI-g-PNIPAm microgel content where the PMHS/water mass ratio was 3/7. a) the fresh prepared Pickering emulsion with different microgel content. b) the Pickering emulsion after centrifuge processing at the speed of 3000 rpm for 15 min. c) the inverted moment of the Figure b.

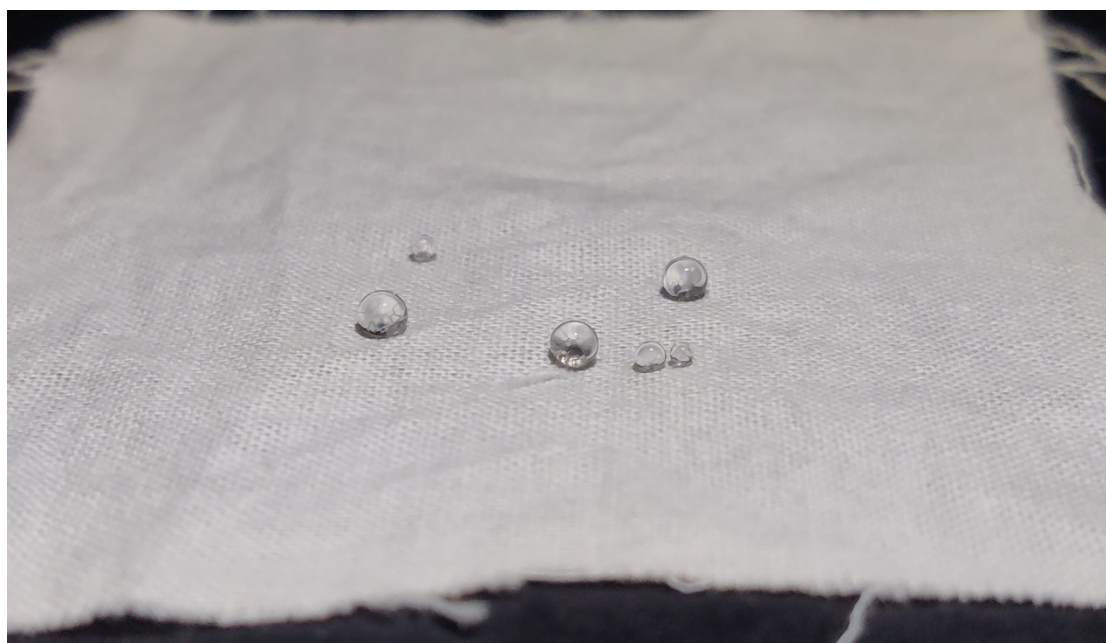


Figure S5. The hydrophobicity of the cotton fiber after soaping wash for four times.