RSC advance

Electronic Supplementary Information (ESI)

Trail of Pore shape and Temperature-sensitivity of Poly(N-isopropylacrylamide) Hydrogels before and after Removing Brij-58 Template and Pore Formation Mechanism

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Characterization

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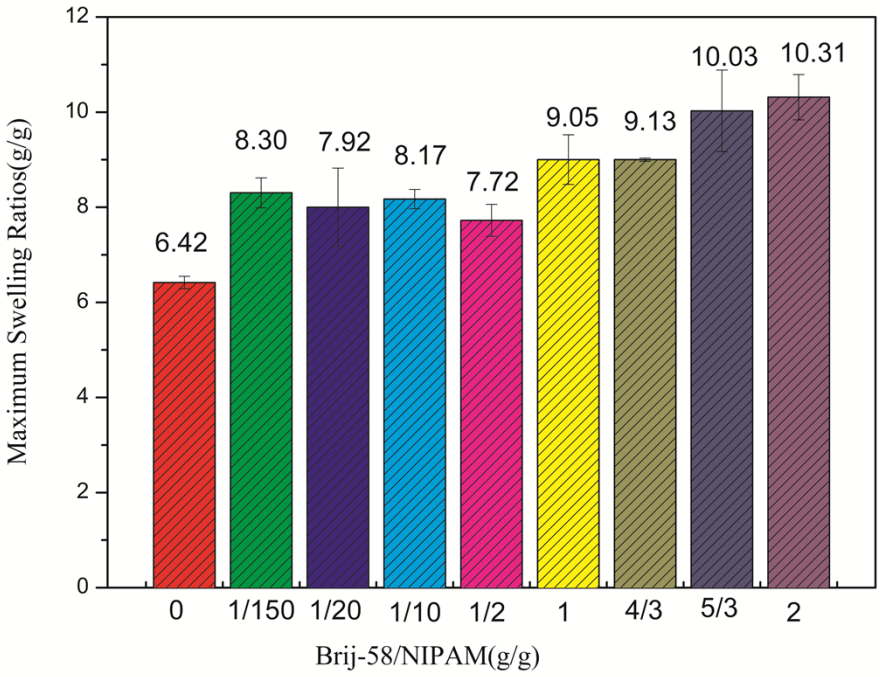

Fig. S1. Maximum equilibrium swelling ratios of CLH hydrogels at 25℃.

To compare the difference of CLH hydrogels in hydrophilicity/hydrophobicity, maximum equilibrium swelling ratios of CLH hydrogels were obtained (see Figure S1 in the Supporting Information). CLH0 hydrogel exhibits lowest equilibrium swelling ratio, 6.3g/g. And when mass ratios of Brij-58/NIPAM are 1/150, 1/20, 1/10 and 1/2, the maximum equilibrium swelling ratios of CLH001, CLH075, CLH15 and CLH75 hydrogels are 8.30, 7.92, 8.17 and 7.72 g/g, respectively. With increasing mass ratios of Brij-58/NIPAM from 1 to 2, the maximum equilibrium swelling ratios of CLH150, CLH200, CLH250 and CLH300 are 9.05, 9.13, 10.50 and 10.31 g/g, respectively. Then, it can be concluded that the introduction of Brij-58 increases the swelling ratios of pure CLH0 hydrogel.

In general, the swelling equilibrium of hydrogel network depends on the osmotic pressure between polymer chains and water molecules, and restricted by cross-linking degree of balance among network flexibility. In fact, no reaction or cross-linking occurs between Brij-58, NIPAM and MBA. Then it is assumed that Brij-58 plays a key role in increasing maximum equilibrium swelling ratios of CLH hydrogels. On the one hand, the chemical structure of Brij-58 is with hydrophilic group like

polyoxyethylene (20). Zhang et al has pointed out that Brij-58 presents highest hydrophilicity in contrast to Brij-52 and Brij-56. On the other hand, it is supposed that Brij-58 serves as a porogenic agent.

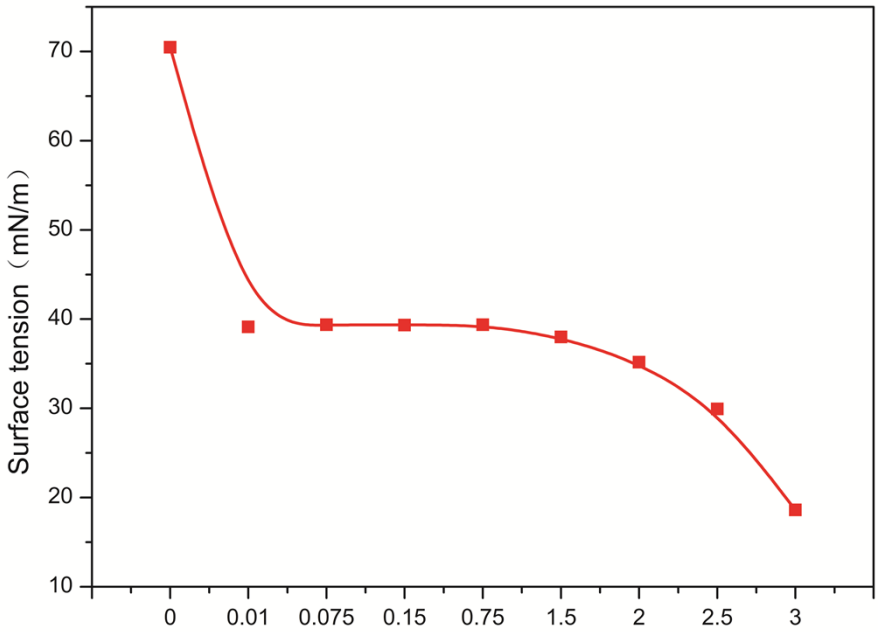

Fig. S2. Surface tension of Brij-58 aqueous solution at different concentration.

The size and shape of Brij-58 template have close relationship with Brij-58 concentration, and then surface tension of Brij-58 aqueous solution with various concentrations was investigated from Fig. S2. It can be observed that the surface tension of pure distilled water is 70.5mN/m, while with introducing Brij-58, surface tension dramatically decreases to 39.1mN/m and then keeps approximately at 39mN/m at concentration from 1 to 75g/L. With further increasing Brij-58 concentration from 150 to 200, 250 and 300g/L, surface tension occurs second decrease and becomes 39.2, 35.2, 29.9 and 18.6mN/m, respectively. The rapid decrease of surface tension at beginning can be attributed to decrease of surface free energy of water resulting from the introduction of hydrophilic/hydrophobic Brij-58. The subsequent equilibrium indicates that Brij-58 molecules still manifest as the formation of micelle. With increasing Brij-58 concentration, Brij-58 molecules form

hexagonal and cubic phases, leading to continuous decrease of surface tension.

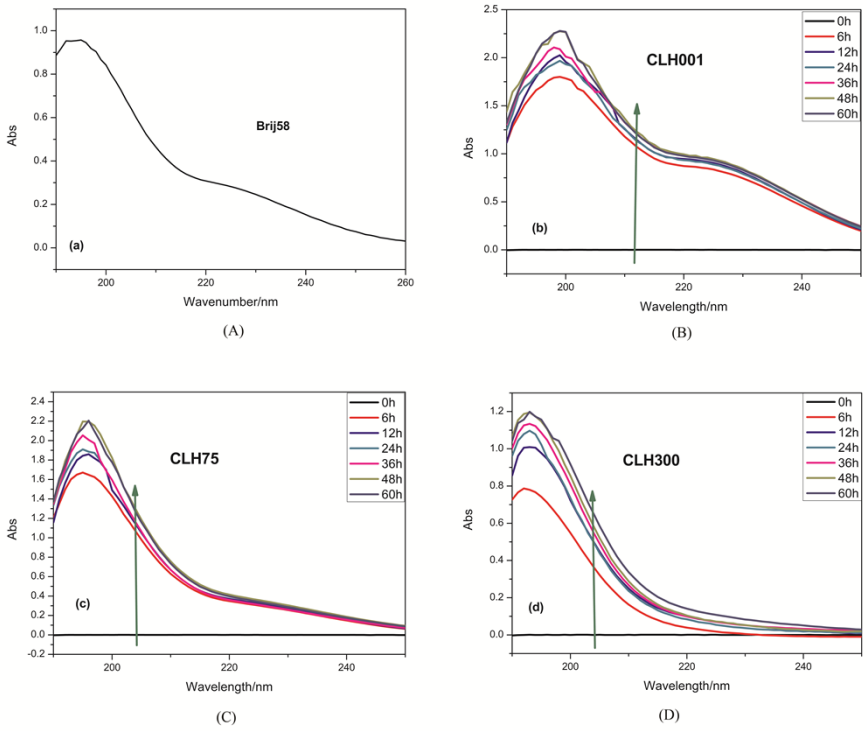

Fig. S3. The absorbance change of CLH hydrogels during the process of removing Brij-58.

To illustrate template action of CLH hydrogels, the UV spectra of Brij-58, CLH0, CLH075 and CLH300 under different removing time are displayed in Fig. S3. Here, the removing time means required time that Brij-58 was completely removed from CLH hydrogel by immersing into the aqueous solution. For Brij-58, an apparent absorption peak occurs at 195 nm. However, for CLH001, CLH75 and CLH300 hydrogels, the absorption peak at 195 nm increases with increasing removing time from 0 to 60 h. It reveals that Brij-58 molecules were gradually removed from CLH hydrogel matrix by immersing into aqueous solution. It is also particularly noteworthy that the two UV/Vis lines of CLH001 and CLH75 at 48 h and 60 h almost coincide with each other, which suggesting that Brij-58 has been basically removed from CLH hydrogel matrix after 48 h.

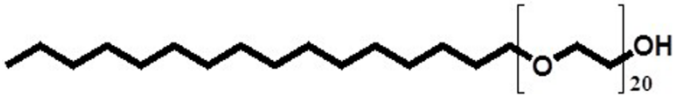

Fig. S4. The chemical structure of Brij-58.

As shown in Fig. S4, "Brij-58" is an ICI trademark name for polyoxyethylene 20 cetyl ether, a nonionic surfactant commonly used in biochemical applications. On a hydrophilic-lipophilic scale (HLB) of 0-20, on which 20 is very hydrophilic (polar), this surfactant has a calculated HLB value of 15.7.[1] The critical micelle concentration (CMC) is reported as 0.007 mM to 0.077 mM; CMC values vary with the salt concentration and temperature.[2]

References

1. Neugebauer, J.M. *Methods in Enzymology* **1990**, *182*, 239-253

2. Helenius, A.; Simons, K. *Biochim. Biophys. Acta* **1975**,*415*, 29-79