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溶剂诱导翻转 Pickering 乳液用于原位循环使用酶催化剂

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Solvent-Induced Inversion of Pickering Emulsions for *In situ* Recycling of Enzyme Biocatalysts

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Experimental Section

Synthesis of the Conventional Immobilized Enzyme Catalyst CALB/DSN

The dendritic silica nanoparticles (DSNs) were prepared according to a previous report [1]. Typically, 68 mg of TEA were added to 25 mL of water and stirred gently at 80 °C in an oil bath for 30 min. Afterwards, 380 mg of CTAB and 168 mg of NaSal were added to the above solution and keep stirring for another 1 h. Then, 4.0 mL of TEOS was added to the H_2O-CTAB-NaSal-TEA solution with gentle stirring for 12 h. The products were collected by high speed centrifugation and washed several times with ethanol to remove the residual reactants. Then, the collected products were extracted with acid ethanol solution at 60.0 °C for 6 h for three times to remove the template, followed by drying in vacuum at room temperature overnight.

After a process of surface modification with organosilane methyltrimethoxysilane, the CALB enzyme was loaded into the large mesochannels of DSNs *via* a simple adsorption. In a typical synthesis, 100 mg of DSNs was dispersed in 7 mL of CALB-PBS solution and stirred at 35 °C for 6 h. The enzyme-immobilized catalyst (CALB/DSN) was collected by high speed centrifugation and washed several times with PBS solution, followed by drying in vacuum at 35 °C overnight.

References

(1) Yang, Y.; Bernardi, S.; Song, H.; Zhang, J.; Yu, M.; Reid, J.; Strounina, E.; Searles D.; Yu, C. *Chem. Mater*. **2016,** *28*, 704. doi: 10.1021/acs.chemmater.5b03963

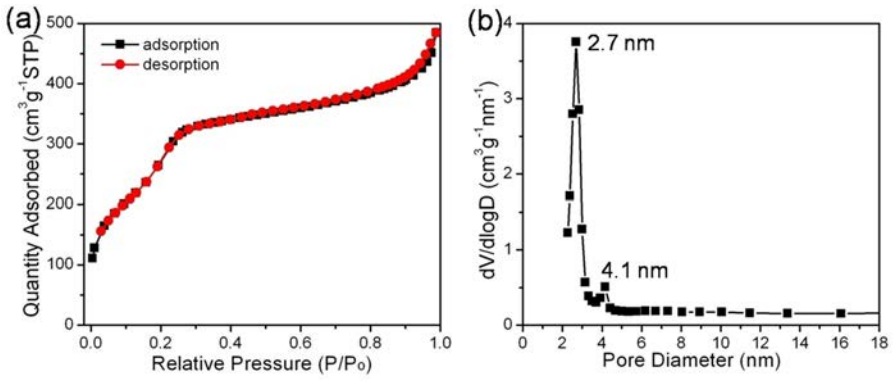

Fig. S1 Nitrogen adsorption-desorption isotherm (a) and pore size distribution (a) of the sample JMSN-5.

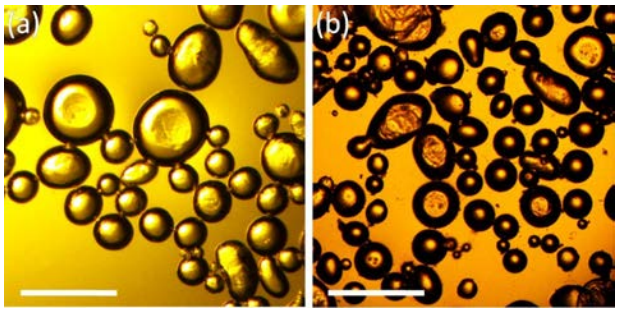

Fig. S2 Optic microscopy images of the Pickering emulsions stabilized by JMSN-5 standing at room temparature for six months (a) or at 80 °C for 4 h (b). The scar bar is 300 μm.

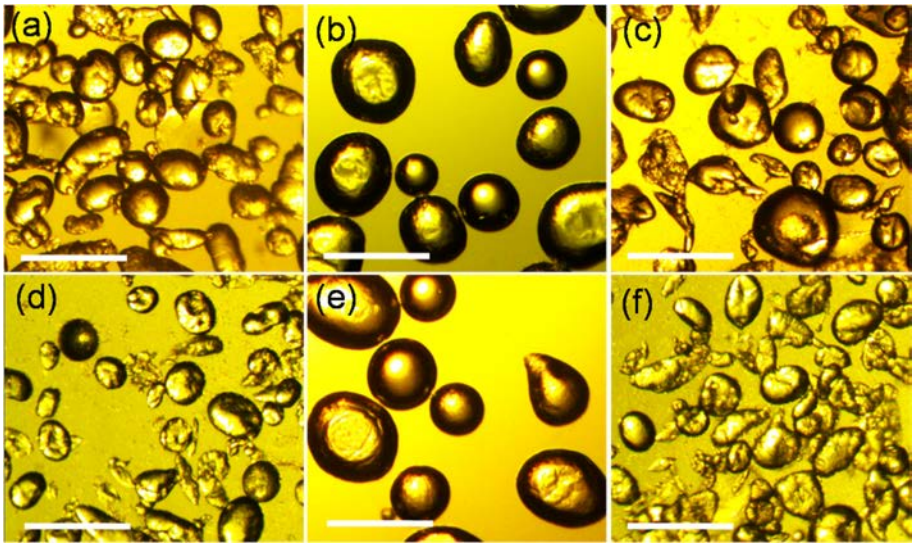

Fig. S3 Optic microscopy images of the Pickering emulsions in the b_1–b_3 (a–c) and in the c_1–c_3 (d–f). The scar bar is 300 μm.

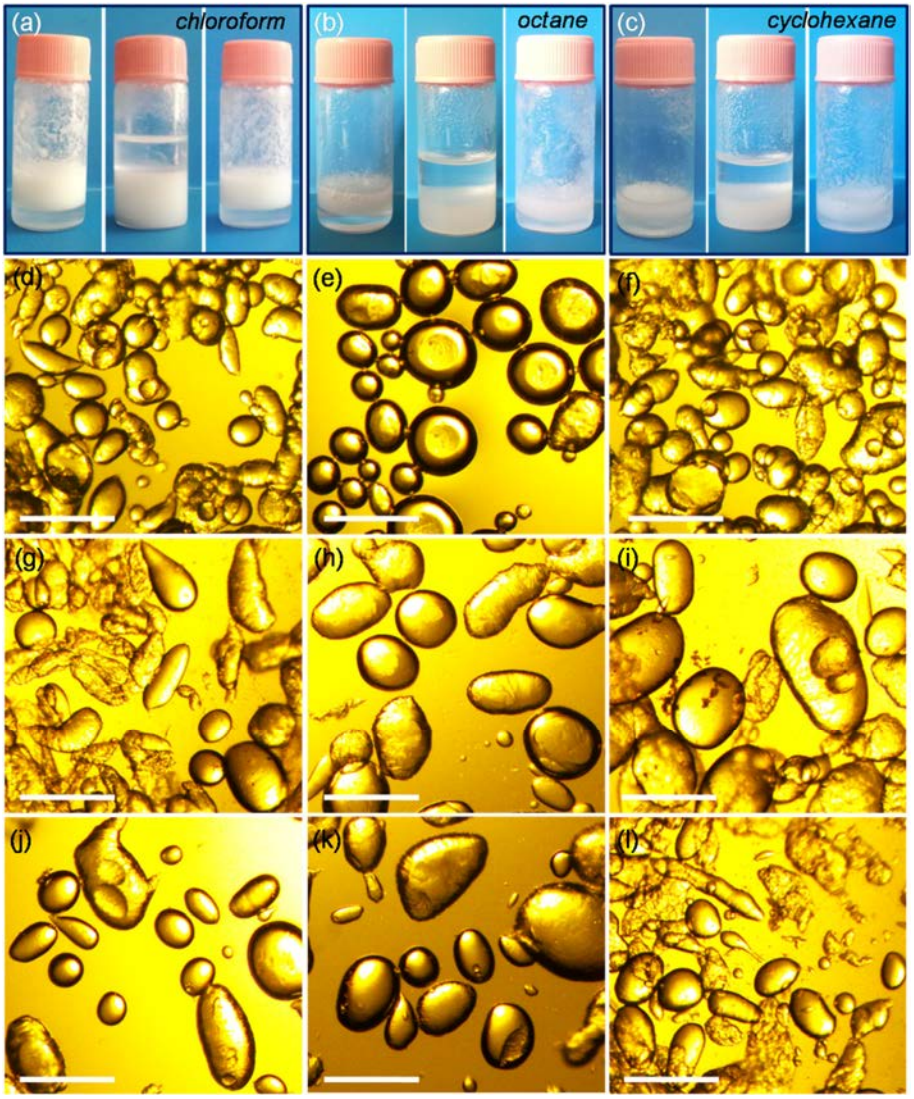

Fig. S4 Appearance of oil-in-water and water-in-oil Pickering emulsions stabilized by JMSN-5 with different oil-water biphasic systems: a) ethyl acetate-water; b) octane-water; c) cyclohexane-water. (d–l) Corresponding optic microscopy images of the Pickering emulsions in the a–c. The scar bar is 300 μm.

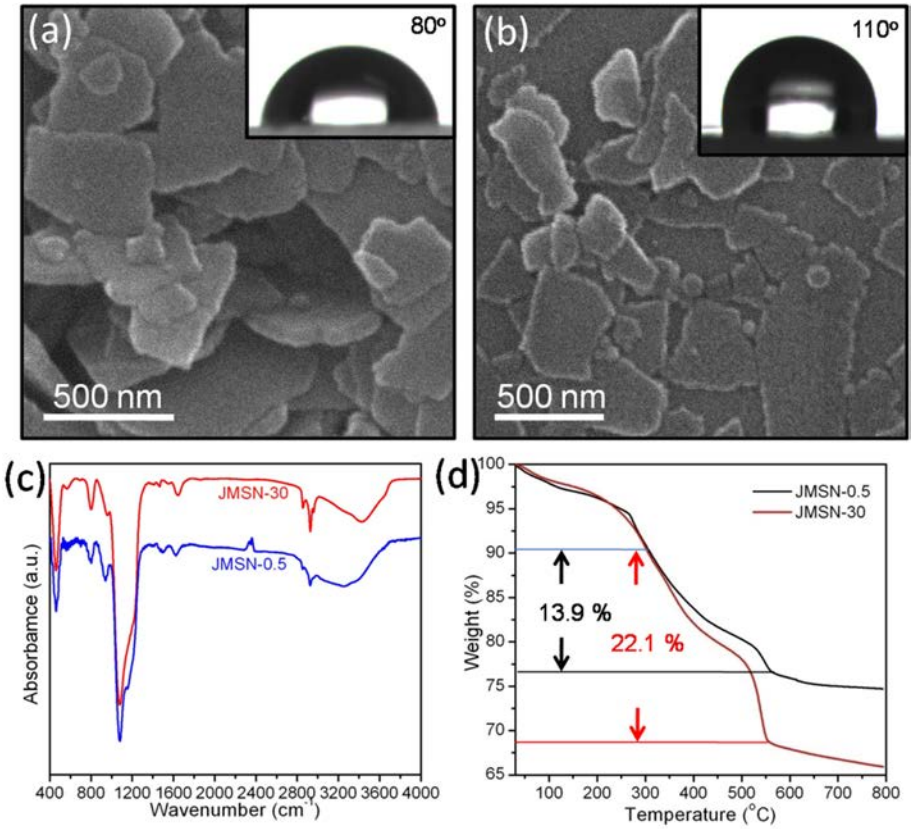

Fig. S5 SEM images of JMSN-0.5 (a) and JMSN-30 (b). FT-IR spectra (c) and TG curves (d) of JMSN-0.5 and JMSN-30. The inset is the corresponding water contact angle.

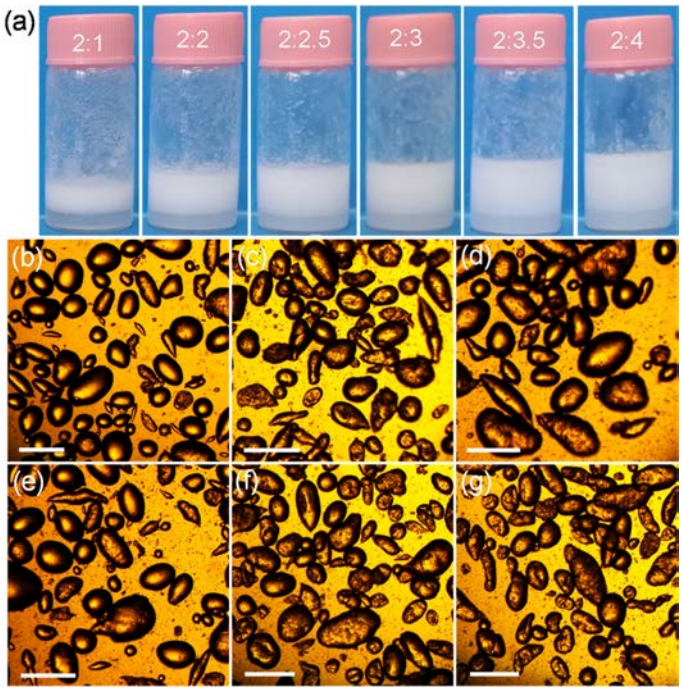

Fig. S6 (a) Appearance of the oil-in-water Pickering emulsions stabilized by JMSN-0.5 under different toluene-water volume ratio. (b–g) Corresponding optic microscopy images of the oil-in-water Pickering emulsions stabilized by JMSN-0.5 under different toluene-water volume ratio. The scar bar is 300 μm.

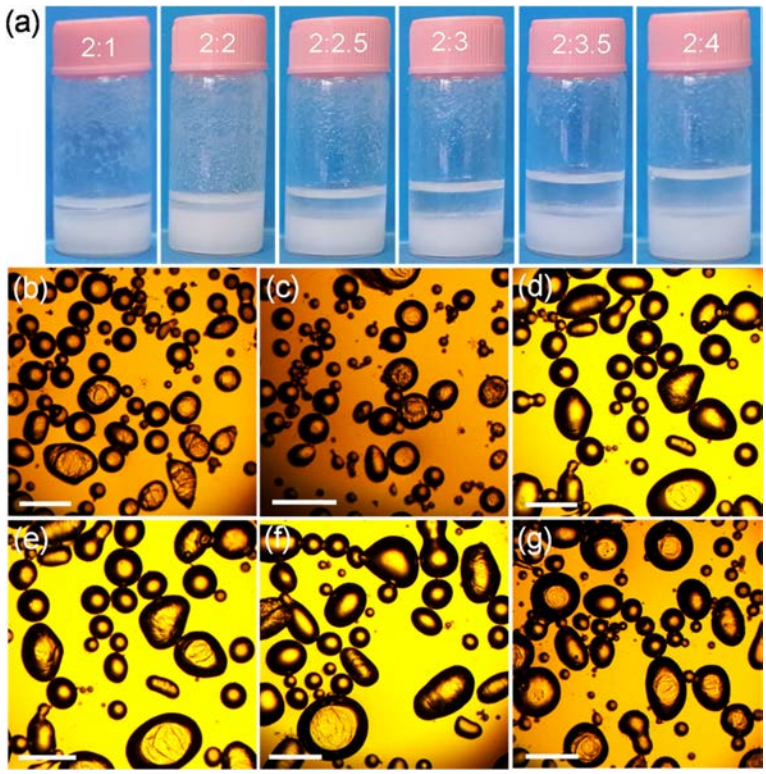

Fig. S7 (a) Appearance of the water-in-oil Pickering emulsions stabilized by JMSN-30 under different toluene-water volume ratio. (b–g) Corresponding optic microscopy images of the water-in-oil Pickering emulsions stabilized by JMSN-30 under different toluene-water volume ratio. The scar bar is 300 μm.

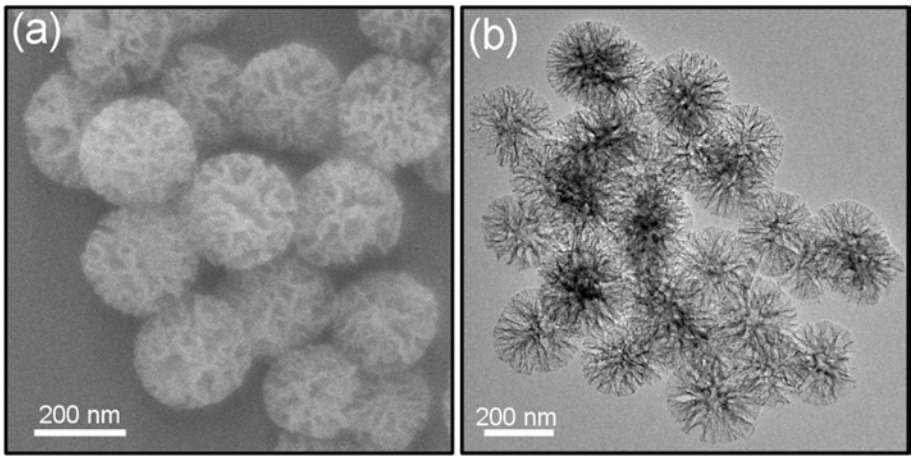

Fig. S8 SEM image (a) and TEM image (b) of the prepared dendritic silica nanoparticles (DSNs). The large mesoporous structure (30 nm) is very favourable for imimmobilizing enzyme biocatalysts.