Supporting Information

Smart Enrichment and Facile Separation of Oil from Emulsions and Mixtures by Superhydrophobic/Superoleophilic Particles

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Figure S1. Size distribution of pristine iron particles (a) and SHIPs (b).



Figure S2. (a) XRD patterns of carbonyl-iron and SHIPs. (b)The magnetic hysteresis loops before and after copper decoration.



Figure S3. SEM images of different particles. (a) Iron particles with smooth surface after treatment in $CuSO_4$ solution without acid. The inset of energy dispersive X-ray (EDX) image shows no copper formation. (b) Copper decorated iron particle after treatment with hydrochloric acid and $CuSO_4$ solution separately. (c) Particles are agglomerated.

Figure S3 shows the importance of acid corrosion for the formation of copper flakes on the surface of iron particles. As carbonyl-iron has poor reaction activity than pure iron, no copper forms on carbonyl-iron particles without the existence of acid in the reaction system (Figure S3a). On the contrary, acid corrosion of the iron powder will continuously form active sites, on which Cu^{2+} will be reduced to copper. Meanwhile, H⁺ takes up part of active sites, so copper is prone to intensively grow and form big nanoflakes (Figure 1d in the main text). A control experiment is carried out using non-acid CuSO₄ solution to react with acid corroded iron particle. The absence of acid leads to poor reaction activity and finally results in the low surface roughness of copper decorated iron particles (Figure S3b). When using acid CuSO₄ solution to react with acid corroded is so fast that the particles are agglomerated (Figure S3c).



Figure S4. Snapshots showing (a) sliding of water droplet (7 μ L) and (b) spreading of kerosene droplet (5 μ L) on the surface of SHIPs coatings.



Figure S5. (a) Size distribution of oil droplets in surfactant-free silicone oil-in-water emulsion. Photographs showing the separation process of the surfactant-free corn oil-in-water (b) and olive oil-in-water emulsions (c), respectively. Photo of a partly separated step with oil marble and translucent liquid is specially shown in (b). Excessive amount of SHIPs was used in (c). (d) The stability of surfactant-free oil-in-water emulsions with time: silicone oil emulsion (left), corn oil emulsion (middle), olive oil emulsion (right).



Figure S6. Invalid separation of Span80 stabilized water-in-kerosene emulsion by directly adding insufficient (a) and excessive (b) amount of SHIPs into the emulsions.



Figure S7. Fluorescence microscope images of the the upper surface of SHIPs in the nylon-SHIPs-nylon composite membrane contacting with the water-in-toluene emulsion. The water droplets were dyed by a gree fluorescent dye. The large green area on the surface of the particles in up layer indicates the membrane has been polluted by the water droplets after the separation of the emulsion.



Figure S8. Flux of separating Span80 stabilized water-in-kerosene emulsion by sandwich-like membrane. Each value was the average flux in each 0.5 min. The experiment was carried out under a pressure difference of 90 kPa.



Figure S9. SEM images showing the fracture section of the solidified paraffin marble.

A lot of the particles embedd on the surface of the marble.



Figure S10. Pictures showing that (a) kerosene and (b) chloroform cannot be separated from the mixtures by using the pristine iron powders.