

Supporting Information

Micrometer-sized gold-silica Janus particles as particulate emulsifiers

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Experimental

Materials

1-Undecanol (purity 99%), poly(ethylene glycol) (PEG: M_n 285-315), ethylene glycol (purity 99%), diiodo methane (purity 99%) and glycerol (purity 99%) were purchased from Sigma-Aldrich. Methyl myristate (purity 95%) was purchased from Wako and was used as received.

Critical surface tension

A critical surface tension of Au substrate was determined by Zisman plot using contact angle measurements of various liquids of known surface tension (in mNm^{-1}): PFS (25.7), styrene (33.1), *n*-dodecane (30.1), methyl myristate (29.6) [1], 1-undecanol (28.5) [1], PEG (43.5) [2], ethylene glycol (47.7) [2], diiodo methane (50.8) [2], glycerol (63.4) [2] and water (72.8) [2].

Au surface

Au surface is categorized to have a “high” surface energy and it is well known that Au surface is readily contaminated by adsorption of organic materials, whose chemical structures are not clear at this stage, in order to decrease surface energy [3]. Several techniques have been developed to obtain clean metal surface: refreezing of melted gold in vacuum [4,5], electrochemical treatment [6], and strong chemical cleaning [7].

References

- (1) Binks, B. P.; Clint, J. H. *Langumur* **2002**, *18*, 1270–1273.
- (2) Fox, H. W.; Zisman, W. A. *J. Colloid Sci.* **1950**, *5*, 514–531.
- (3) Butt, J. H.; Graf, K.; Kappl, M. *Physics and Chemistry of Interfaces*, 2nd ed.; Wiley-VCH Verlag GmbH & Co. KGaA: Weinheim, **2006**
- (4) Gardner, J. R.; Woods, R. *J. Electroanal. Chem.* **1977**, *81*, 285–290.
- (5) Smith, T. *J. Colloid Interface Sci.* **1980**, *75*, 51–55.
- (6) Schrader, M. E. *J. Colloid Interface Sci.* **1984**, *100*, 372–380.
- (7) Dote, J. L.; Mowery, R. L. *J. Phys. Chem.* **1988**, *92*, 1571–1575.

Figure S1 (a-c) Digital photographs, (d-f) optical microscopy images and (g-i) SEM images of (a,d) 2D SiO₂ and (b,e) Au-SiO₂ Janus particle colloidal crystal on glass substrate and (c,f) glass substrate after removal of the Au-SiO₂ Janus particles.

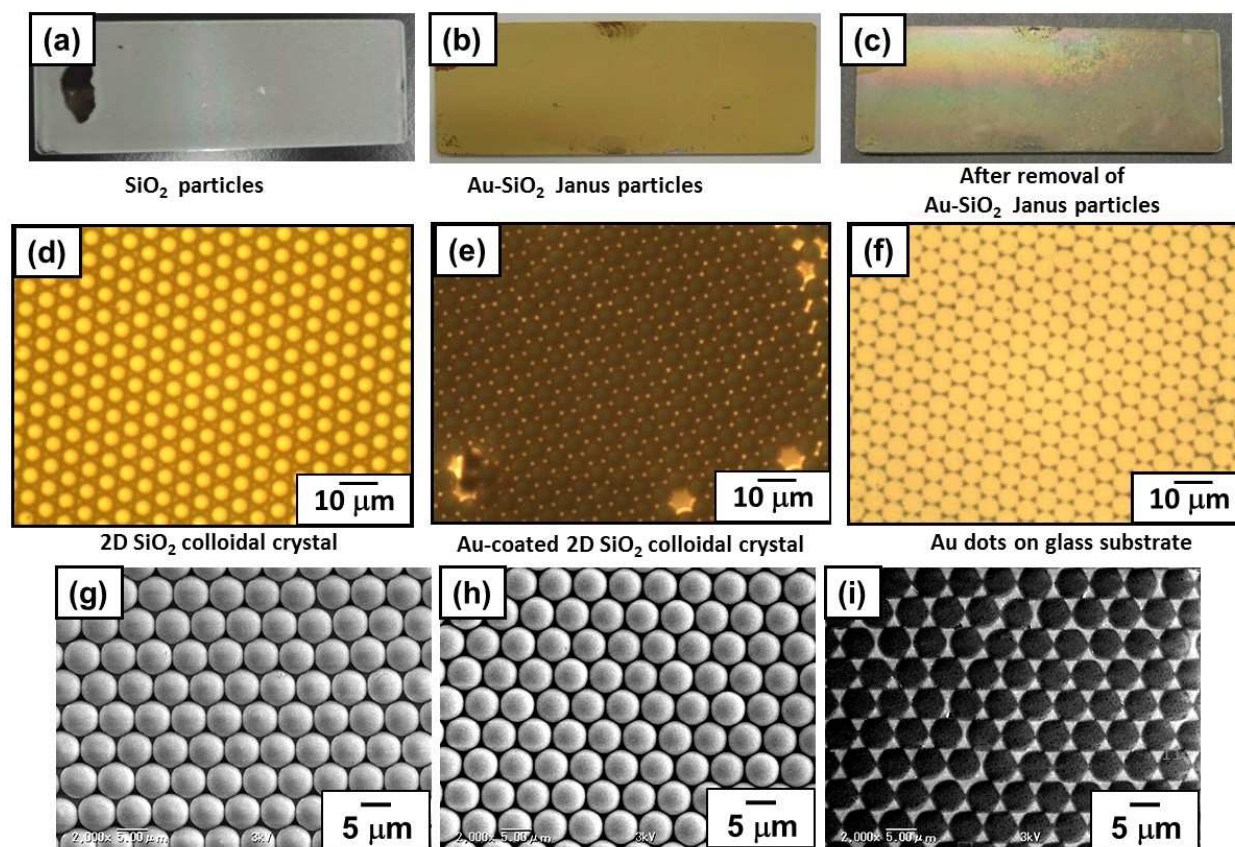


Figure S2 SEM image of Au-SiO₂ Janus particles

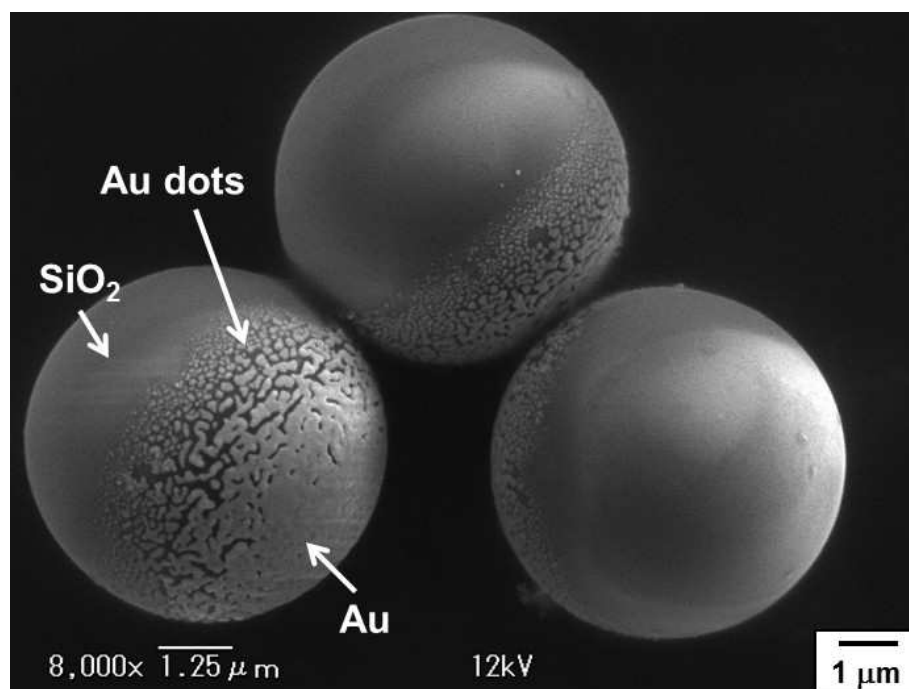


Figure S3 OM image of Au-SiO₂ Janus particle clusters formed by hydrophobic interactions in water media with an aggregation number (n) of 42.

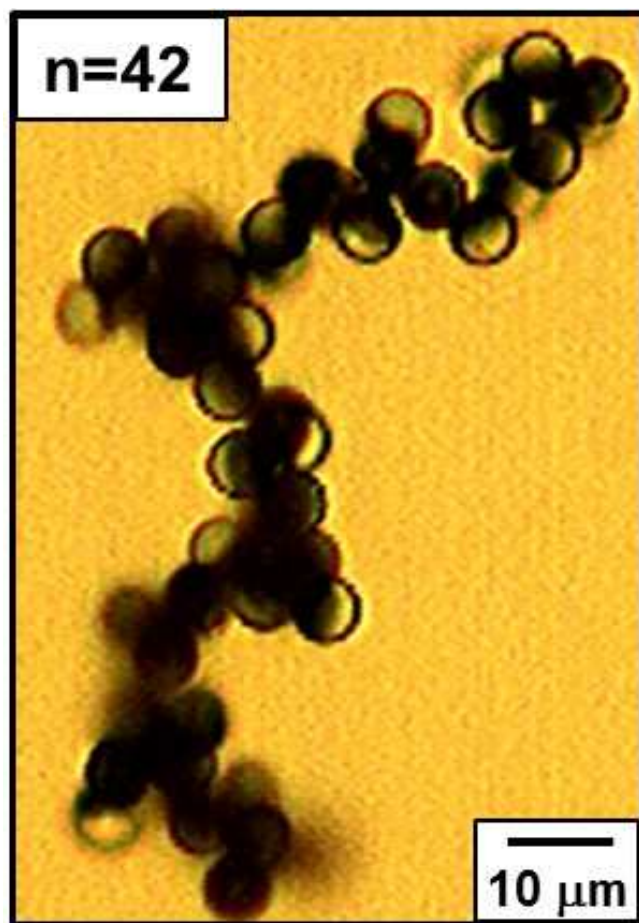


Figure S4 OM images of Au-SiO₂ Janus particles dispersed in aqueous media: (a) before and (b) after stirring using a touch mixer (Vortex Genius 3, IKA[®]) at 3,000 rpm.

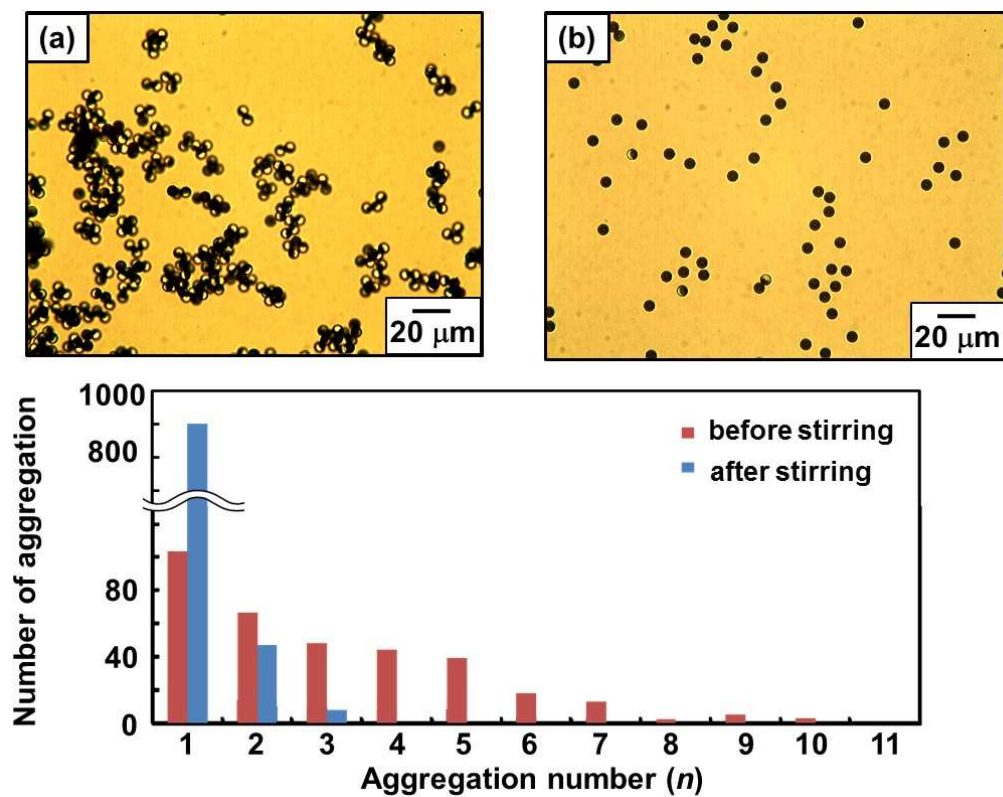


Figure S5 OM images of Au-SiO₂ Janus particle-stabilized toluene-in-water emulsion before (a) and after (b) evaporation of toluene

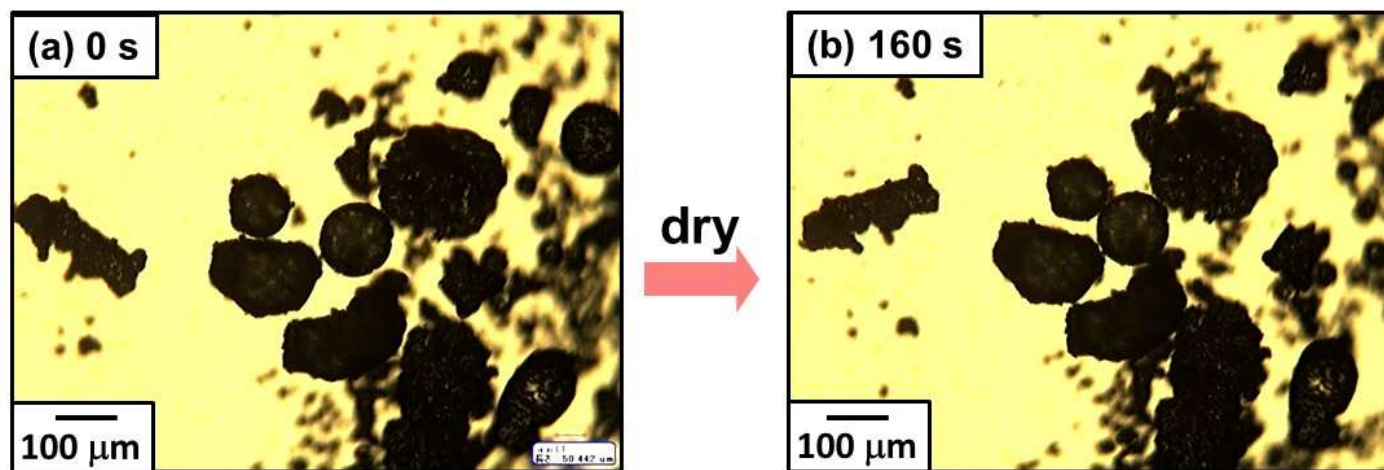


Figure S6 Digital camera images of “Pickering-type” emulsions stabilized using Au-SiO₂ Janus particles at different Janus particle concentrations (0.5, 1.0 and 2.0 wt%)

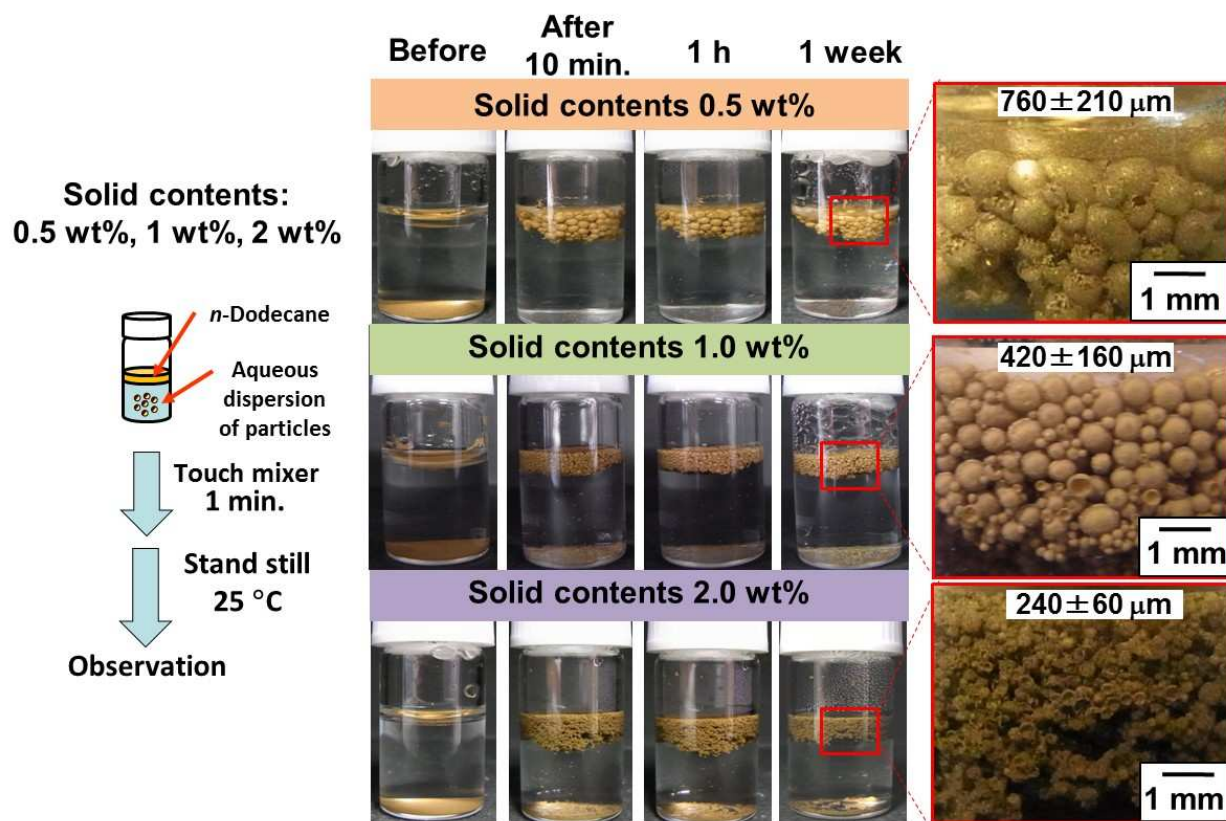


Figure S7 Zisman plot of contact angle versus surface tension of solvent for various liquids on Au-coated glass. The critical surface tension $\gamma_{Au} = 32.6 \text{ mNm}^{-1}$ is determined by extrapolating the liquid data to of contact angle = 1.

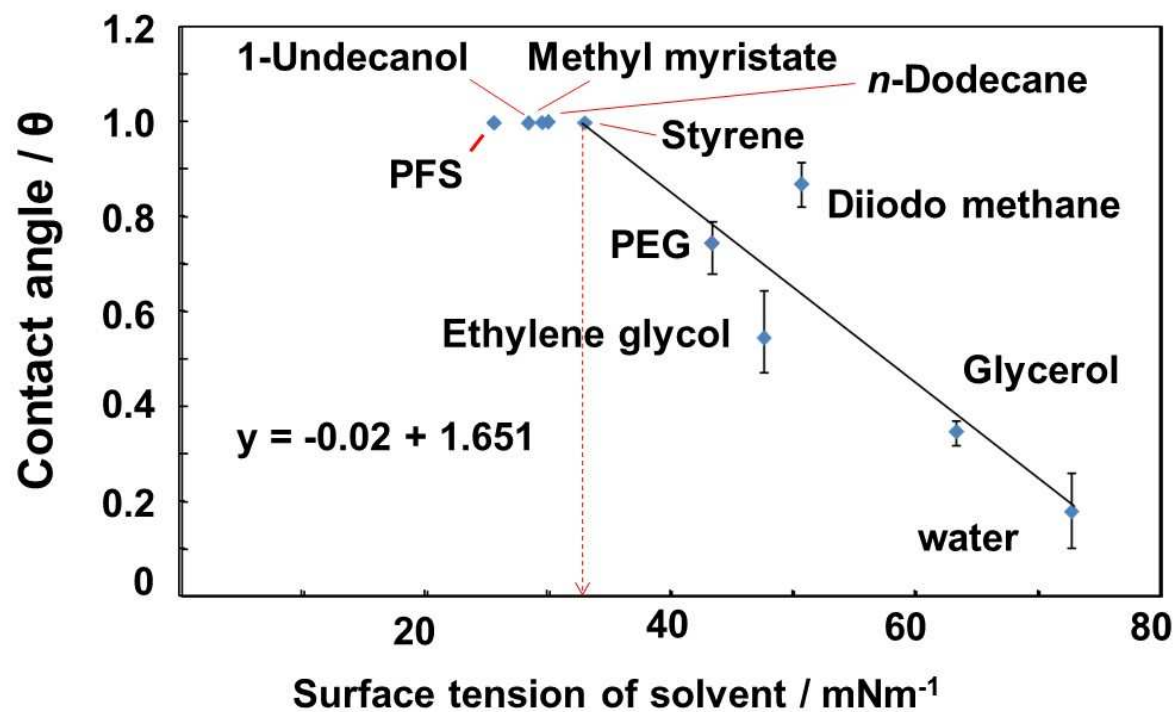


Figure S8 Contact angles of (a) Au-SiO₂ Janus particle and (b) SiO₂ particle at 2,3,4,5,6-pentafluorostyrene (PFS)-water interface

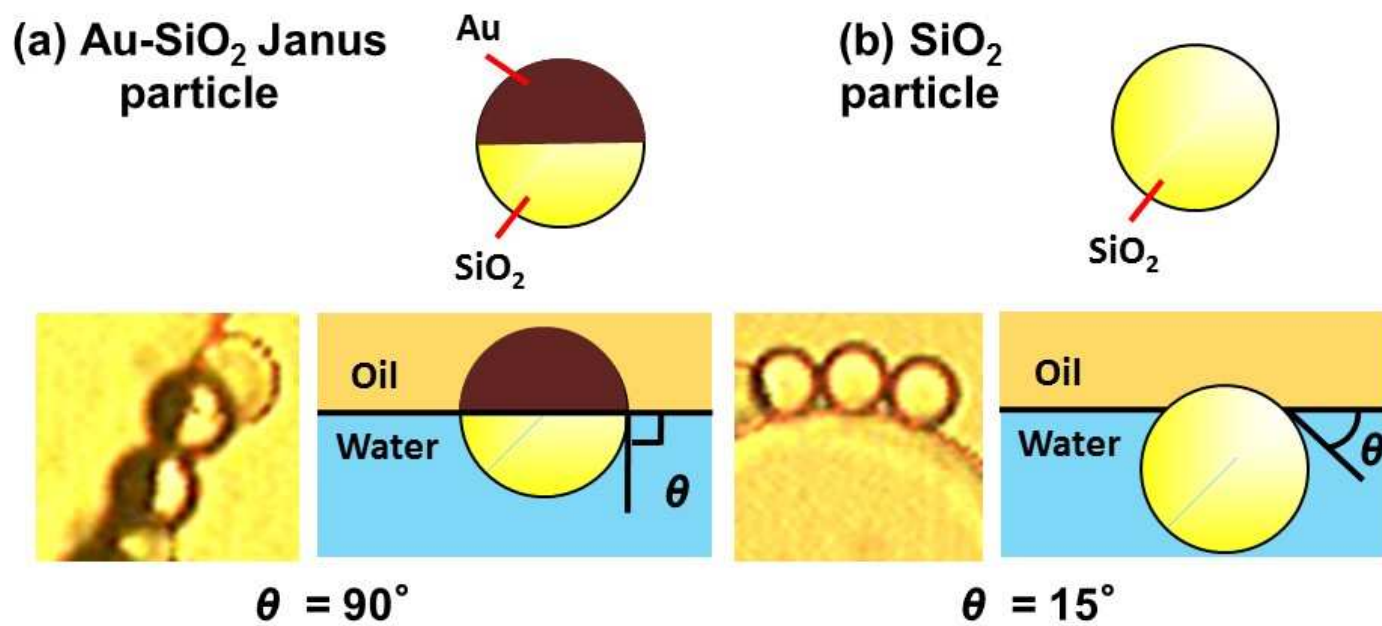


Figure S9 (a) Digital photograph and (b) OM images of 2,3,4,5,6-pentafluorostyrene (PFS)-in-water “Pickering-type” emulsions stabilized with Au-SiO₂ Janus particles.

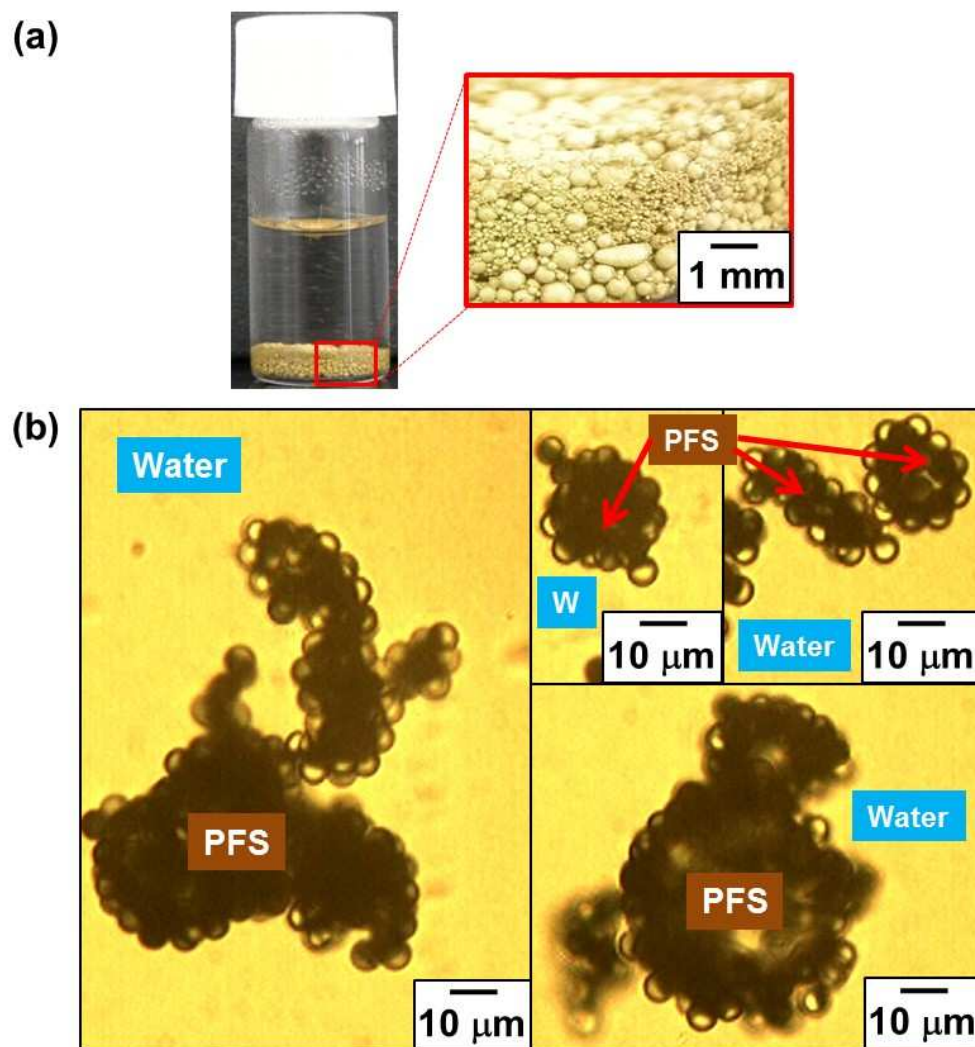


Figure S10 SEM image of cross section of the PPFS microspheres carrying Au femto-litter cups on their surface. Inset shows magnified image.

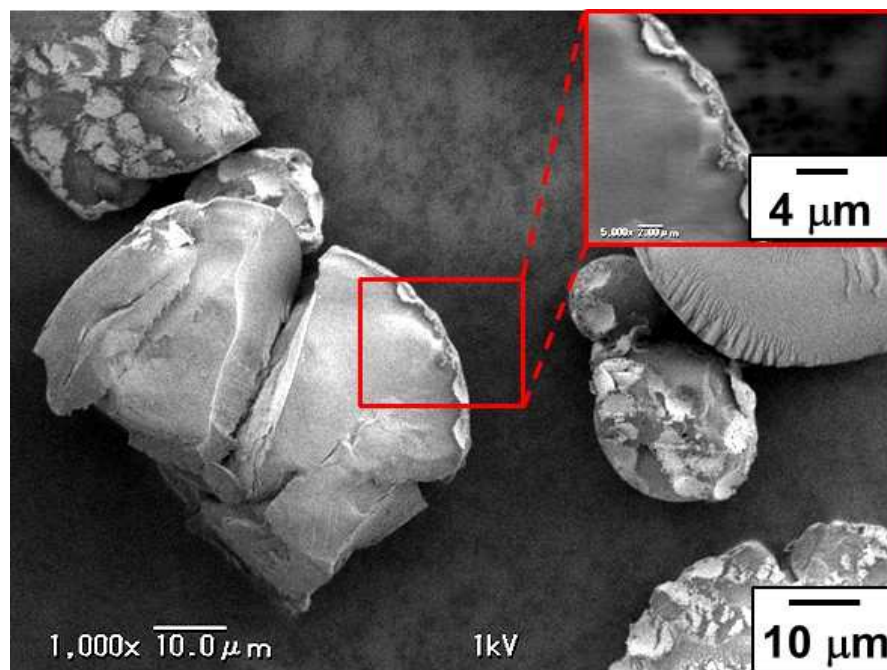
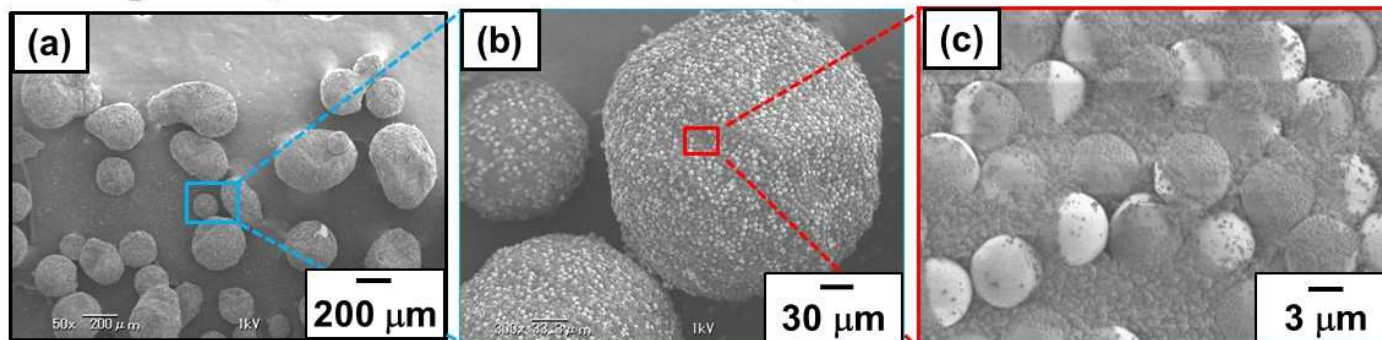


Figure S11 (a-e) SEM images of the Janus particle-stabilized PS microspheres. (d,e) Cross section image of the microsphere.

Au-SiO₂ Janus particles-stabilized PS microspheres



Cross-section images of the PS microsphere

