Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Compartment Fabrication of Magneto-Responsive Janus Microrod Particles

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Experimental

Fabrication of magneto-responsive Janus microparticles: An ethanol suspension containing 5 wt% silica particles (500 nm in diameter, Alfa Aesar) was dropped onto PDMS mold with cylindrical holes (10 μm diameter, 20 μm depth, and 15 μm pitch), followed by blading the silica suspension across the PDMS mold using a glass slide. After complete evaporation of ethanol, an ethanol suspension consisting of 5 wt% silica particles (500 nm in diameter) and 0.2 wt% iron oxide (α-Fe_2O_3) nanoparticles (< 50 nm in diameter, Aldrich) was dropped onto PDMS mold and allowed ethanol to evaporate in a convection oven at 65 °C for 5 min. Then, the PDMS mold was placed on diglycidyl ether of bisphenol A-based epoxy resin (DER 354, Dow Chemical) containing 3 wt % photoinitiator (Cyracure UVI 6976, Dow Chemical)-coated glass substrate to infiltrate the resin into the cavities of mold by capillary force. To induce the alignment of the magnetic moment of iron oxide nanoparticles within the cylindrical cavity, two disc-type magnets was applied to the top and bottom of the system for 30 min before UV curing of the epoxy resin at 365 nm at a dosage of 17 J/cm^2. After releasing the PDMS mold from the substrate, the resulting magnetic Janus microparticles were released from the glass substrate by scraping the micropillar array using a razor blade. To achieve well-dispersed microparticles in water, 1 wt% Pluronic® F108 (ethylene oxide–propylene oxide–ethylene oxide triblock copolymer surfactant, BASF) was used to coat the microparticles.

Coupling of dye molecules with silica particles: For coupling of green dye molecules, fluorescein isothiocyanate (FITC, Aldrich) molecules were first bonded with 3-(aminopropyl)trimethoxysilane (APTMS, Aldrich). FITC (0.0015 g) was dissolved in 2 mL ethanol and 0.237 mL APTMS was added to the ethanolic solution and reacted for 12 h under mild stirring. Separately, 6.5 mL ethanol suspension containing 1 wt% silica particles (500 nm in diameter) was mixed with 0.551 mL ammonia for 10 min, followed by addition of 0.1 wt% NaOH aq. solution for 10 min to activate the silanol groups. Subsequently, 20.8 μL FITC–APTMS ethanolic solution and 48.75 μL tetraethoxysilane (TEOS,

Aldrich) were sequentially added to the suspension and the mixture was allowed to react for 48 h under mild stirring. Finally, an additional 50 μL TEOS was added to coat the FITC–APTMS treated silica particle surface to prevent UV absorption by the dye molecules. In a similar manner, tetramethyl rhodamine isothiocyanate (TRITC, Aldrich) was used as a red dye molecule to graft onto the silica particles. Briefly, TRITC (0.0015 g) was dissolved in 1.8 mL ethanol and reacted with 0.09 mL APTMS for 12 h under mild stirring. The resulting solution was subjected to the same procedures as those for green dye coupling. After successful coupling of the dye molecules, the silica particles were washed with ethanol several times and then redispersed in fresh ethanol.

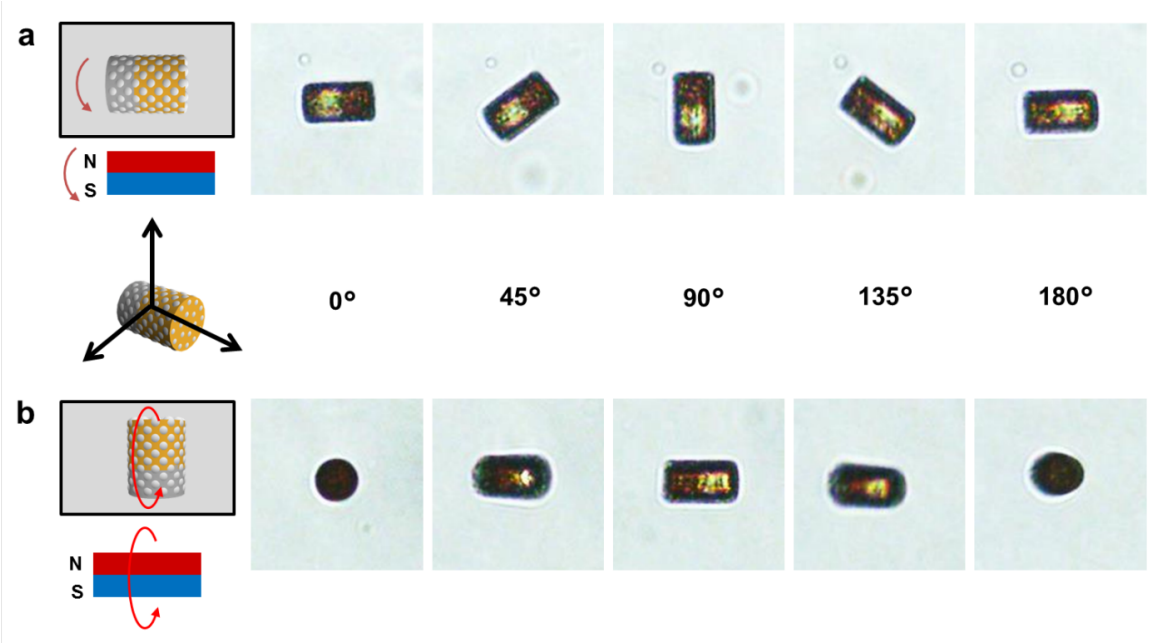

Figure S1. Illustration and optical microscopy (OM) images of (a) rotational motion of the magnetic Janus microparticles under an external magnetic field induced by a rotating magnet with a vertical axis and (b) flip motion of the Janus particles by a rotating magnet with a parallel axis.

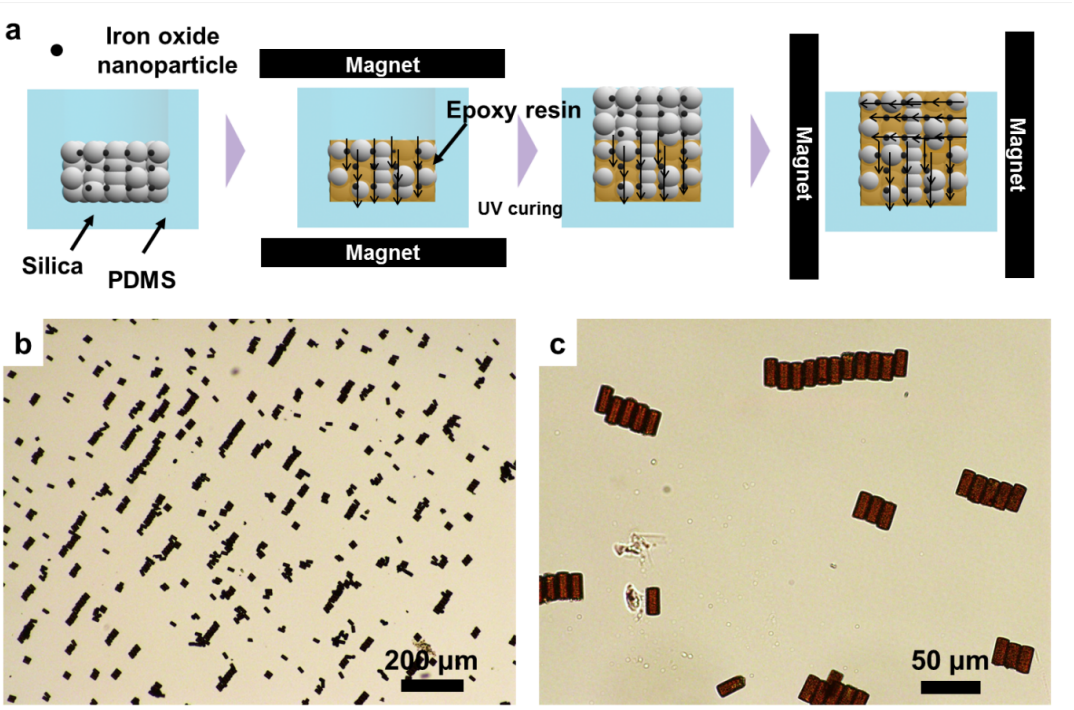

Figure S2. (a) Schematic illustration of the fabrication of magnetic Janus particles consisting of perpendicular magnetic moments in the adjacent blocks. Silica particles/iron oxide nanoparticles were partially filled into the mold, followed by partial infiltration of epoxy resin and application of the magnetic field. After curing of epoxy resin, second infiltration of silica particles/iron oxide nanoparticles and epoxy was applied with the magnetic field applied to the whole system perpendicular to the first one. (b, c) OM images of side-to-side aggregation of solely magnetic microparticles which have a perpendicular magnetic moment to long axis of microparticles without an external magnetic field.

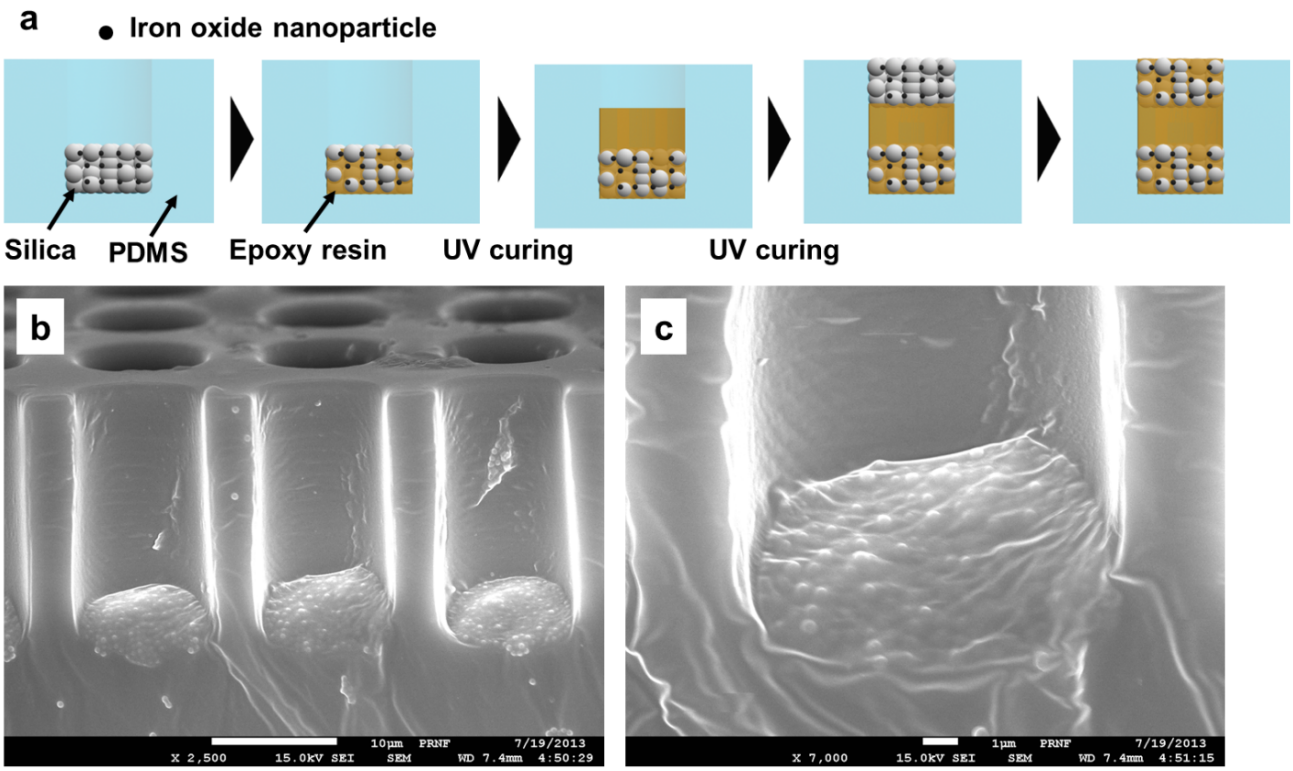

Figure S3. (a) Schematic illustration of the fabrication of the diblock and triblock Janus particles. It included fractional deposition of silica particles/iron oxide nanoparticles, followed by partial infiltration and curing of epoxy resin. (b, c) SEM images of partially deposited silica particles within the cylindrical holes obtained after curing of epoxy resin.