Simple Preparation of Magnetic Field-Responsive Structural Colored Janus Particles

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Experimental Section

Materials

The fine silica particles (KE-W30) were purchased from Nippon Shokubai. The average particle diameter of the fine silica particles was measured using a disk centrifugal particle size distribution measuring device (CPS Disc Centrifuge DC 24000 UHR). In the case of spherical fine particles, a very accurate average particle size and particle size distribution can be measured. We used silica particles with an average diameter of 277 nm and with low values of coefficient of variation (CV) (< 5%).

The nanoparticles made of Fe₃O₄ were FerroTec EMG 1111 (average particle diameter 10 nm) (Ferrotec Corporation, USA).

Pure water was obtained by purifying and deionizing tap water with a MILLI-Q Labo system (MILLIPORE).

A solution in which 2 wt% Span 80 (Tokyo Chemical Industry Co., Ltd.) was dissolved in hexadecane (Tokyo Kasei) was used as the oil phase.

Measurements

A UV-vis spectrometer (Nippon Bunko Company, V-670) with an absolute reflectance measurement unit (ARMN-735) was used to measure the reflectance spectra. A schematic diagram of the optical setup for the measurement of the spectra is shown in Fig. S4. The incidence angle relative to the normal of the planar surface of the glass plate was 0°. The measurement angle, θ , was 10° relative to the normal of the planar surface of the glass plate. Fiber-optic spectrometer (Ocean optics, USB 2000) was also used to measure the reflection spectra. The arrangement of the silica particles in the colloidal amorphous array was investigated with a scanning electron microscope (SEM; Hitachi, Miniscope TM3000). The samples were coated with a 10-nm Au-Pd layer, and the SEM was operated at 15 kV. Elemental analysis was performed with energy dispersive X-ray spectrometry (EDX). A digital microscope (KEYENCE, VHX-500F) was used to photograph the structural colors of the samples.



Figure S1. Simple preparation method for monodisperse Janus particles with two different structural colors.

a) Silica 20 wt%



c) Silica 40 wt%

b) Silica 30 wt%



d) Silica 50 wt%



Figure S2. Polydisperse Janus particles prepared by using a w/o emulsion and adding 1.7 wt% Fe_3O_4 nanoparticles to aqueous suspensions of 20-50 wt% of the silica component, Scale bar: 100 μ m.

Table S1. Based on Figure S2, the average particle size of the Janus particles prepared using various amounts of the silica component and their CV values.



Figure S3. Dependence of the average particle diameter of the Janus particles on the amount of silica added based on Fig. S2.



Figure S4. Schematic representation of the reflection spectrum acquisition method for Fig. 3 $(\theta = 10^{\circ})$ and Fig. 4 $(\theta = 0^{\circ})$.