Supplementary Information

Biomimetic non-iridescent structural color materials from polydopamine black particles that mimic melanin granules

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Experimental Section

Materials

Dopamine hydrochloride (DA), tris(hydroxymethyl)aminomethane (Tris), and methanol were obtained from Kanto Chemical. Deionized water with a resistance of 18.2 MΩ was obtained by passed through Millipore Simplicity UV system. All other chemicals and solvents were of reagent grade and used as received.

Analysis

The hydrodynamic diameter (D_h) of the particles in water was measured by dynamic light scattering (DLS) (ELSZ; Otsuka Electronics). Scanning electron microscopy (SEM) micrographs were obtained using a scanning electron microscope (JSM-6510A; JEOL). Reflection spectroscopy was performed using a spectrophotometer (V-650; JASCO) equipped with a reflection spectroscopy unit (ARSV-732; JASCO).

Typical synthesis of PDA black particles

DA (0.9-2.2 mg/mL, 2.1-5.2 mmol), Tris (5.4 g, 45 mmol), and water/methanol (4/1) solution (450 mL) were placed in a flask, and the mixture was stirred at 30 °C for 20 h. The PDA black particles were separated and purified repeatedly by centrifugation (14 500 rpm for 20 min) and redispersed in deionized water.

Preparation of structural color plates from PDA black particles

Structural color plates from PDA black particles plates were fabricated by pouring 10 wt% PDA suspensions ($PDA_{170,204,256}$ black particles) into a silicone rubber mold and allowing the suspensions to dry at room temperature for 24 h.

Preparation of structural color films from PDA black particles

The 1.0 mL of 0.5 wt% PDA suspensions ($PDA_{166,213,275}$ black particles) was loaded into the airbrush with nozzle size of 0.2 mm (MJ722; Airtex). Spray coating was conducted using air compressor (APC018; Airtex), and the distance between the airbrush and the substrate (black wooden board) was kept at approximately 20 cm. After spraying PDA suspensions, the films were kept and dried at room temperature.

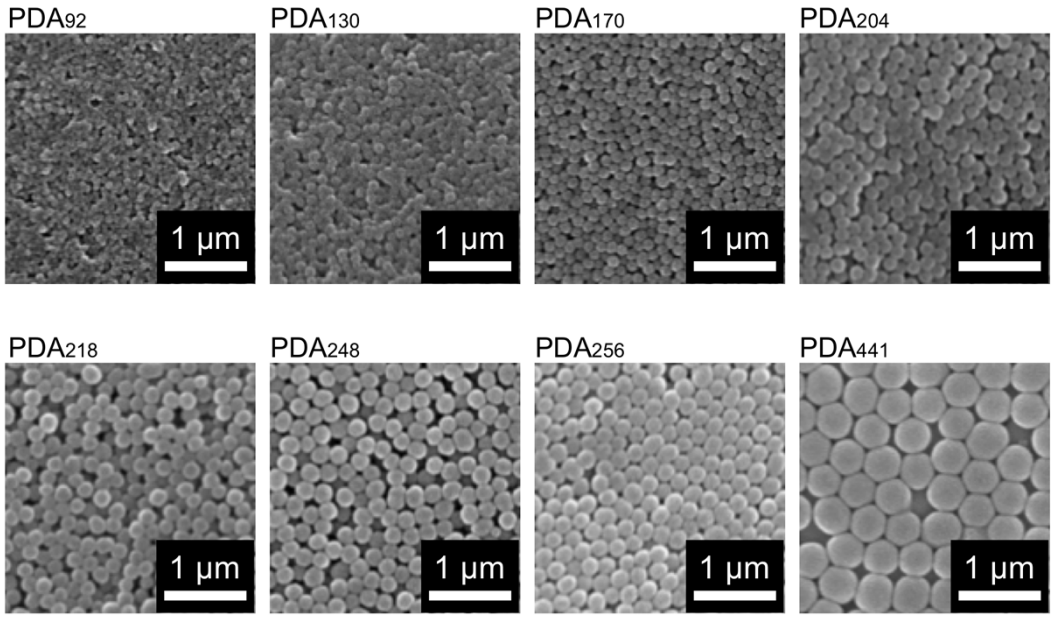

Fig. S1 SEM images of amorphous structures prepared by PDA black particles.

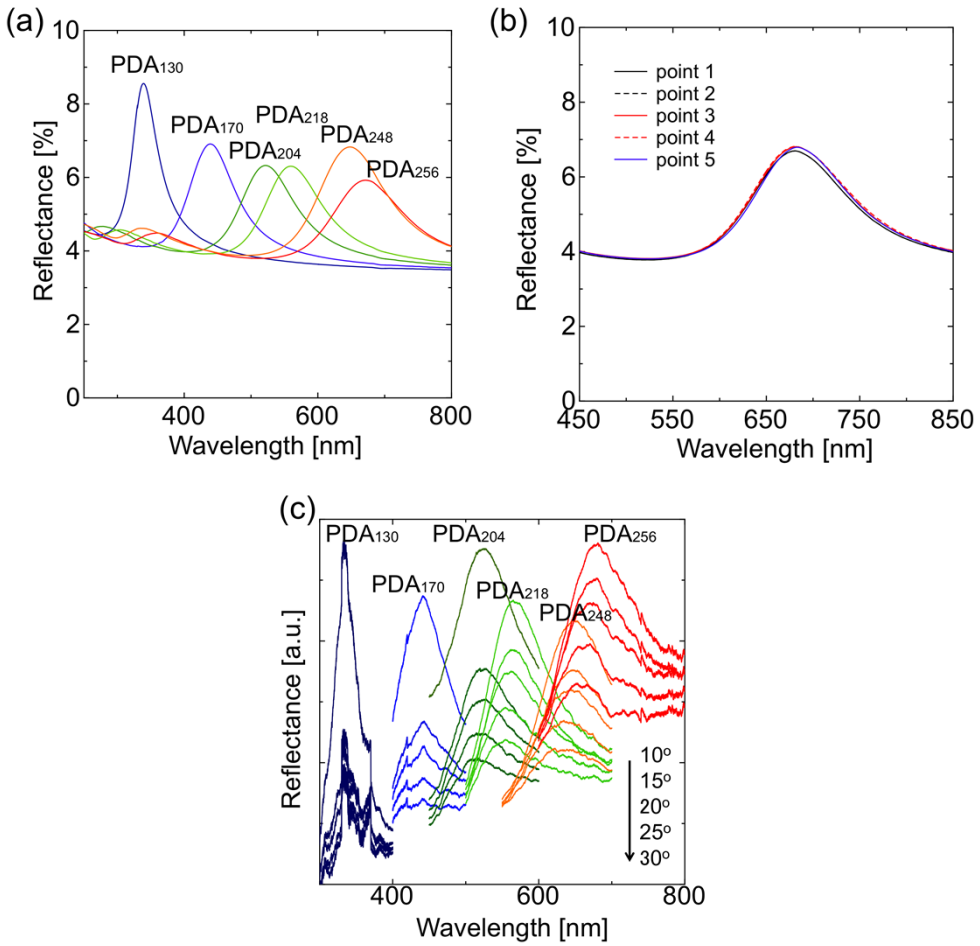

Fig. S2 (a) Raw reflectance spectra of samples. (b) Differences of spectra in different parts of cells. Five points were randomly selected (PDA_{256}). (c) Reflectance spectra for amorphous structures prepared by PDA black particles.

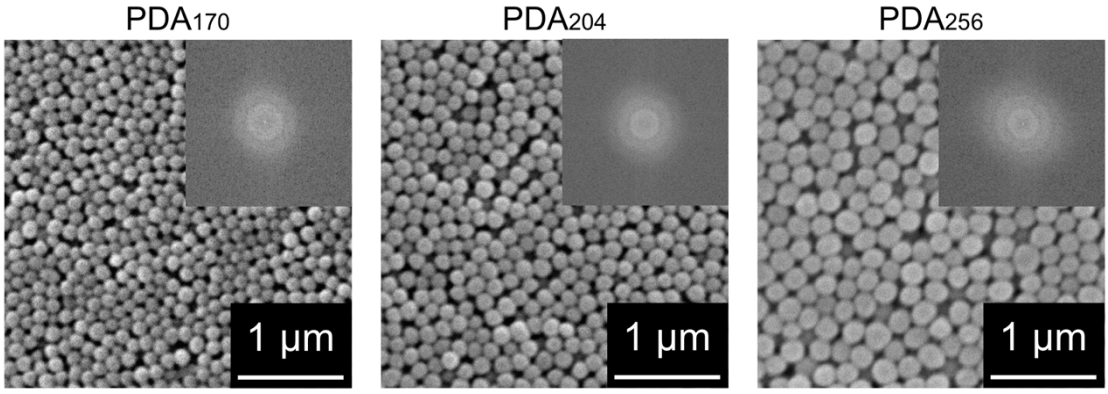

Fig. S3 SEM images of amorphous structures prepared by PDA black particles. Insets show 2D-FFT spectra from SEM images.

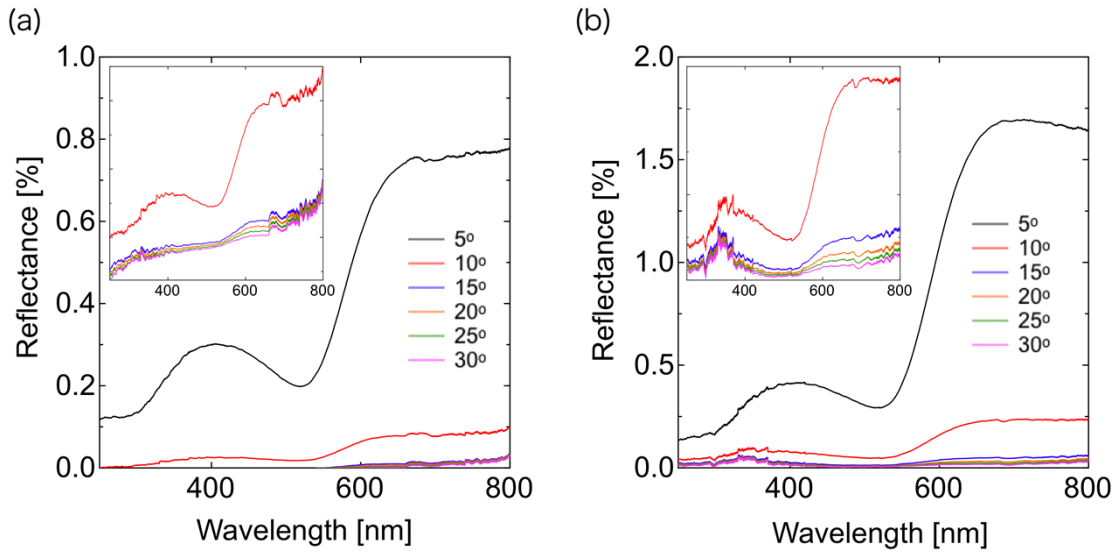

Fig. S4 Raw reflectance spectra of structural color plates composed of PDA_{256}. (a) Exterior side (metallic). (b) Interior side (matte).