Synopsis of Original Research Paper

Morphology control of monodispersed inorganic pigment particles and their characterization.

Kazuhiko Kandori

School of Chemistry Osaka University of Education

The morphology and texture of hematite particles producing from a forced hydrolysis reaction of $FeCl_3$-HCl solution were controlled by dimethylformamide (DMF) and dioxane (DX). The morphology of synthetic hematite particles was concentration dependent; they changed from large sphere with diameter of ca. 600 nm to diamond-like shape with increasing DMF concentration in the aging solution accompanying a reduction of their size to 80 nm without incorporation of DMF in the particles. This fact was explained by an acceleration of phase transformation from β-FeOOH to hematite with an elevation of the solution pH owing to dimethylamine produced from a hydrolysis of DMF at an elevated temperature. TEM and XRD suggested that the diamond-like hematite particles formed above 6~10 vol% DMF possess a single crystal nature. TG and FTIR indicated that the hematite particles produced with DMF contained small amounts of OH^- ions in the lattice though they provided a single crystal nature. On the other hand, the spherical shape of haematite particles produced below the DX concentration of 10 vol% (diameters: 600~1000 nm) was changed to cubic one after producing the particles at more than 12 vol% DX (mean edge lengths: 900~1200 nm). The rod-like β-FeOOH particles were precipitated to be cubic ones at the DX concentration $\gtrsim$ 28 vol%. TEM and XRD suggested that the haematite particles formed in the presence of DX are polycrystalline with an enlarged c dimension in a unit cell. TG and FTIR indicated that the haematite particles produced with DX are hydrohaematite possessing OH^- ions in the lattice as well as the particles produced with DMF. The results obtained in the present study revealed that variation of the polarity of the medium with addition of DX is a determining factor of the particle size and shape rather than the interfacial tension of the medium and the particles. In the case of aluminum phosphate particles, the size of spherical particles was controlled by using urea and isopropylamine (IPA) and their texture was investigated by various means. The mean particle diameter (Dp) of the particles decreased with increase in the concentration of urea by accelerating the precipitation reaction from decomposition of urea at elevated temperature. The Dp decreased by addition of IPA up to 6 mol% to Al ions under a constant urea concentration, while Dp increased above the concentration because IPA produced electrolytes by reacting with HNO_3; the electrolytes may reduce the range of coulombic repulsion between charged primary particles. All the particles adsorbed selectively H_2O molecules. IPA does not act as a template but operates as an effective additive for controlling the particle size without altering the inner texture of spherical aluminum phosphate particles. It was revealed from the results that both the hematite and aluminum phosphate particles are produced from the aggregation of small primary particles.