

ABSTRACT

Due to their extraordinary colour properties, like wide range nuances and high values of colour strength, organic pigments are widely used in paint industry. However, at present their applicability is limited, mainly because they are rapidly degraded by UV light especially in the presence of photocatalysts. The aim of the present work was to protect two typical organic pigments using an appropriate surface functionalization procedure. The first important step of this procedure involves a surface modification of pigment using different surface active agents (SAA) and a polyelectrolyte. The second step includes the formation of a silica shell on the modified pigment particle surface. The influence of SAA and polyelectrolyte type, as well as of different parameters used for protective layer synthesis (temperature, pH, amount of added SiO₂ and use of a layer by layer technique) on the properties and durability of encapsulated pigment particles was studied in detail. It is worth noting that protection of organic pigments particles against photocatalytically generated reactive species has not been reported so far. Similarly, a layer by layer technique using waterglass as a precursor is reported for the first time. As model organic pigments Pigment blue 15:3 that chemically corresponds to copper phthalocyanine (CuPc) and Pigment Red 254 that chemically corresponds to 3,6-bis(4-chlorophenyl)pyrrolo(3,4-c)pyrrole-1,4-dione (DPPCl) were chosen. Due to different chemical structure, these pigments have different surface properties. It was found, for both pigments, that the decrease in colour intensity in the presence of photocatalyst and UV irradiation is accompanied by release of CO₂ in H₂O. This strongly indicates that the pigment degradation took place *via* an oxidation reaction. Dispersion of blue pigment particles, CuPc, and cationic SAA showed a narrow particle size distribution and a positively charged particle surface. After encapsulation, the modified CuPc particles were covered by a silica shell, spread uniformly over the entire pigment surface. Dispersions of red pigment particles, DPPCl, prepared using different SAA (cationic, nonionic, mixed micelle system) and a polyelectrolyte, exhibited different properties. Only the dispersion containing a mixed micelle system led to a narrow particle size distribution and, after encapsulation, to a continuous silica shell spread over the entire pigment surface. It was found that encapsulation carried out at lower pH values led to more continuous silica shells. By contrast, synthesis temperature mainly affected the thickness and porosity of silica shell, with thicker and less porous silica shells being formed at higher temperatures. However, at the same time, these conditions led to a smaller portion of encapsulated pigment particles. Using a layer by layer encapsulation technique, the silica shell got thicker, less porous and covered a larger portion of particles by adding each new layer. Thus the best protection against photocatalytically generated reactive species was achieved by forming a double-layered shell around CuPc and a triple-layered shell around DPPCl.

Keywords: phthalocyanine, diketopyrrolopyrrole, SiO₂ shell, encapsulation, modification, photocatalysis