Synopsis of Original Research Paper

Creation of Colorful Titanium Oxide Inorganic Pigments and Functional Evaluation as Cosmetic Materials

Shu Yin

Institute of Multidisciplinary Research for Advanced Materials, Tohoku University

B and N co-doped anatase (BN-Ana), rutile (BN-Rut), and brookite (BN-Bro) TiO_2 were successfully synthesized by a hydrothermal assisted nitridation method. The apparent color of as-obtain BN-Ana, BN-Rut and BN-Bro was red, cyan and yellow-green, respectively. The mechanisms of various coloring were concluded as the different band gap configurations and the formation of covalent B-N bonding. The nitridation time expressed less effect on changing the color. On the contrary, the nitridation temperature enabled the distinct color changes by altering the brightness. The lower temperature, the fewer doping concentration, and brighter apparent color, vice versa. Through tuning the brightness, a gradient of yellow-orange-red was achieved in the case of BN-Ana, as well the transitions of grey-to-cyan and white-to-green-yellow were achieved in BN-Rut and BN-Bro, respectively. This research proposed a method for the synthesis of color-full titania pigment without the addition of other toxic transition metal elements. It was also found that the color titania with various phase composition possessed different photocatalytic activity. The results indicated that BN-Bro was the most active species, showed almost the same level photocatalytic activity as Degauss P-25 titania under UV light ($\lambda > 290$ nm) or blue-free visible light ($\lambda > 500$ nm) irradiation, while it shows higher activity under $\lambda > 400$ nm irradiation. The photocatalytic durability of BN-Bro decreased to about 44 % of its original activity after five times cycling test. On the other hand, the photocatalytic activity of BN-Ana and BN-Rut show quite low photocatalytic deNOx activity, indicating that BN-Ana and BN-Rut are potential candidates for toxic-free pigment or cosmetic applications