Synthesis of Hematite-Alumina Red Pigment for porcelain

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Introduction

In the ceramic industry, many natural and synthetic pigments had been used many practical applications as coloring agents in glasses, enamels and unglazed bodies. The synthetic pigments were widely used for the production of colored traditional glazed and unglazed porcelain. The pigment for porcelain had to be thermally stable at the firing temperature and toward the actions of molten glasses (frits and/or glazes).

Hematite (α-Fe_2O_3) particles have been widely utilized in many technologies, such as pigments, catalysts, coatings, flocculants, cosmetics, electronic materials, and abrasives. There are many commercially available α-Fe_2O_3 powders for use as red pigment for Japanese porcelain enamel. However, the tone of red color of α-Fe_2O_3 pigments was strongly influenced by the particle size, morphology and aggregation of the pigments. It was important that the color-stable pigments, which were not affected by morphology and dispersal behavior, were synthesized for use as thermally stable red pigments.

The present work was to study the possibility of synthesizing red inorganic pigments for ceramic applications by composite of α-Fe_2O_3 – α-Al_2O_3.

Methods

Reagent grade $Fe(NO_3)_3$ $9H_2O$, $Al(NO_3)_3$ $9H_2O$ and ammonia solution were used. Aqueous iron nitrate solution, aluminum nitrate solution and ammonia solution added to the aqueous media were stirred in beaker for 24 h at room temperature. The supernatants in these solutions were removed after aging for 48 h at room temperature. The various precipitates were rinsed with de-ionized water. The Characteristics of the synthesized powders fired at various temperatures were estimated by X-ray diffraction (XRD) and spectrophotometer.

Results and Discussion

The α-Fe_2O_3 and α-Al_2O_3 were observed by XRD measurements after firing (900 – 1300°C). The chemical solid-state reactions between α-Fe_2O_3 and α-Al_2O_3 were observed in all powders obtained in the studied firing temperature range by lattice parameter of α-Fe_2O_3 and α-Al_2O_3. The color of the powders was analyzed by spectrophotometer based on the L^*(lightness), a^* (red/green intensity), and b^* (yellow/blue intensity) test. The color difference was evaluated by ΔE value calculated from L^*, a^* and b^* value. Compared with the color difference of powders fired at 1000°C and 1300°C, the ΔE value of 33 mol% Fe (67 mol% Al) added powder showed the minimum value. As the result, it was considered that 33mol% Fe powder was thermally stable red pigment at studied firing temperature range.

About Myself

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About My Affiliation

The Gifu Prefectural Ceramic Research Institute is a public institution in gifu prefecture. The institute was established on 1911. The main aim of this institute is to contribute the development of the ceramic industry by technological support. The institute performs research and provides technical support related to ceramic products such as ceramic ware, tile, refractory and advanced ceramic materials.