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A NEW METHOD FOR COLORING ANODIC OXIDE FILMS ON ALUMINUM

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A new hydrothermal treatment of anodic oxide films on aluminum was proposed by the use of water containing cobalt(II) oxide at 280 °C in an autoclave. A reaction of the alumina on the film with cobalt(II) oxide resulted in the formation of cobalt(II) aluminate. The color of the film was a vivid bright blue.

As methods for coloring anodic oxide films on aluminum, electrolytic and integral coloring and dyestuff dyeing are generally used.[1] The method presented here is entirely different from conventional methods in that the film produced is not pure boehmite but contains cobalt(II) aluminate.

The anodic oxide films used in the experiment were prepared by the anodic oxidization of a 99.85% purity aluminum plate (1S) in a 15 vol% sulfuric acid bath, applying a direct current of 1 A dm^{-2} for a period of 30 min at 20 °C. Prior to the anodizing, the aluminum plate was cleaned by the usual method. The thickness of the anodic film was 10±0.5 μm. In carrying out the hydrothermal treatment, the anodized aluminum plate was heated at a rate of 3.5 °C min^{-1} in a suspension of 1 g of cobalt(II) oxide in 85 cm^3 of water in an autoclave.

The color of the films after the hydrothermal treatment was examined from the reflectance curves and the results are shown under CIE (Commission Internationale de l'Eclairage)[2] in Table 1. The values for the dominant wavelength (λd), the exciting purity (Pe) and lightness (Y) showed that the color is blue for all the films. With increasing temperature or time of hydrothermal treatment, the blue color became more vivid and distinct. The film treated at 280 °C showed a bright blue color like a cobalt blue pigment.[3] Figure 1 shows the X-ray diffraction

patterns of the treated films. Boehmite was detected in films treated at 150-250 °C. The film treated at 280 °C showed, in addition to faint boehmite patterns, strong diffraction patterns of cobalt(II) aluminate spinels,[3] having formed from the alumina and cobalt(II) oxide. The diffraction peaks of the spinels became more fully developed with an increase in treatment time. With films treated in water containing no cobalt(II) oxide, only boehmite was observed to form at certain temperatures between 200 and 280 °C (Fig. 2).

Table 1. Color of hydrothermally treated anodic oxide film

Treating conditions		C I E		
Temp/°C	Time/h	Y/%	λd/nm	Pe/%
200	5	47.49	476.5	10.1
250	5	29.15	476.4	36.0
250	10	23.35	476.1	42.5
250	20	17.59	475.5	52.9
280	5	15.44	475.3	58.1
280	10	10.46	473.4	69.5
Cobalt blue pigment[a]		13.58	473.3	67.5

a) T. Kuwahara and T. Ando, "Ganryo Oyobi Enogu," Kyoritu Syuppan, Tokyo (1979), p. 20.

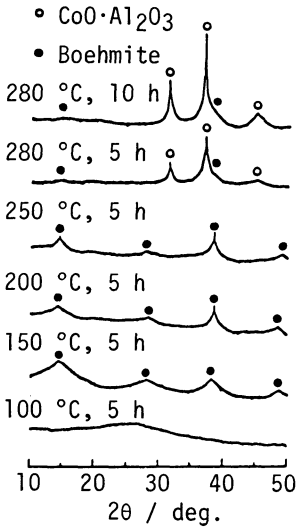

Fig. 1. X-Ray diffraction patterns of film treated with cobalt(II) oxide.

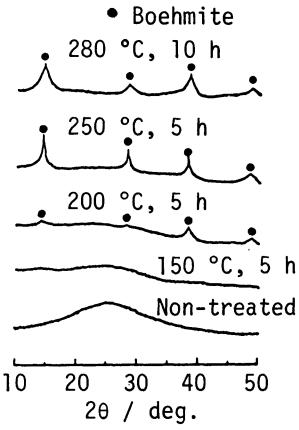

Fig. 2. X-Ray diffraction patterns of film treated in water containing no cobalt(II) oxide.

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