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Electrochemical Property of Fe_2O_3-Cr_2O_3 Thin Films Formed by LP-MOCVD

LP-MOCVD법으로 합성한 Fe_2O_3-Cr_2O_3계 박막의 전기화학적 특성

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The purpose of this study was to examine the relationship between the corrosion resistance and the crystallinity of the Fe_2O_3-Cr_2O_3 artificial passive films and to give some insight on the relationship on the real passive films.

The Fe_2O_3-Cr_2O_3 films were formed on Pt substrates by low pressure MOCVD technique using iron (III) acetylacetonate and chromium (III) acetylacetonate as precursors at substrate temperatures of 150-350℃. The thickness and the optical constants of the films were determined by a rotating analyzer type automatic ellipsometer. The chemical composition of the films was determined by inductively coupled plasma-emission spectroscopy (ICPS) analysis. The oxidation state of constituent elements of the films was examined by X-ray photoelectron spectroscopy (XPS). Micro- and crystal structures were examined by transmission electron microscope (TEM) and electron beam diffraction (ED), respectively. The films coated on Pt plates were immersed in 1.0 M HCl for a given time and the decrease in film thickness was measured by ellipsometry. Potentiodynamic polarization curves were measured in 1.0 M H_2SO_4 and 0.5 M HCl by a potentiostat.

The films deposited above 300℃ had crystalline structures and those, deposited below 250℃ had amorphous structures. The films deposited above 250℃ had a high amount of M-O type chemical bonds, and those deposited below 200℃ had high amount of M-OH type chemical bonds. The films deposited above 300℃ hardly dissolved in 1.0 M HCl and those deposited below 250℃, however, easily dissolved in the solution. The dissolution rate of the films in the solution increased with decreasing substrate temperature. Passive and transpassive current densities of the films in 1.0 M H_2SO_4 were dependent on the substrate temperature and increased with decreasing the temperature. When polarized cathodically in 1.0 M H_2SO_4 and 0.5 M HCl, the films deposited below 250℃ dissolved due to the reduction of Fe_2O_3 component in the films. The reduction of Fe_2O_3 component was, however, suppressed on the films deposited above 300℃. Therefore, with increasing crystallinity and amount of M-O type chemical bonds, the corrosion resistance of the films increases in HCl and H_2SO_4 solutions.