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ETCHING RATES OF TiO_2 THIN FILMS GROWN BY ATOMIC LAYER DEPOSITION

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One possibility to avoid corrosion of chemically active metal surfaces is using sealing coatings on top of the surfaces. Thin and ultra-thin inorganic films can be used as such type of anti-corrosion coatings if they fulfill all necessary sealing properties: high chemical inertness, low gas diffusion, good adhesion to the substrate surface, at least a certain elasticity, and they can be prepared defect free and with uniform surface coverage. Then the coatings will work as gas (oxygen, water, etc.) barriers and avoid any corrosion of surfaces. Atomic layer deposition (ALD) ensures ideal surface coverage and should also yield films with high density and low defect concentration. Therefore the method should have marked application perspectives in preparation of anti-corrosion coatings. In this work, the chemical inertness of TiO_2 thin films grown by ALD was investigated through determination of the etching rate in acidic environments. The films of 80–250 nm thickness were grown in a flow-type ALD reactor using $TiCl_4$, $Ti(OC_3H_7)_4$ (titanium tetraisopropoxide) or TiI_4 as metal precursors for growing TiO_2. H_2O or H_2O_2 were applied as second precursors. Etching was carried out in hot sulphuric acid (80%, 110 ºC). Thickness of the films and its change during the etching was measured ex-situ with the help of X-ray micro- and/or X-ray fluorescence analysis methods in order to determine the etching rate. Accuracy of both methods was examined.

Changes in the topography of films caused by etching were studied with an atomic force microscopy working in the non-contact mode and with a high-resolution SEM.

Expectedly the etching rate decreased with the increase of deposition temperature. Most significant changes in the etching rate were observed, however, at temperatures, at which the films started to crystallize. It is noteworthy that TiO_2 films grown in the iodide process at lower temperatures ($T \leq 200$ ºC) were more resistive to etching than those grown in the $Ti(OC_3H_7)_4$-based process, and vice versa for the coatings prepared at higher temperatures.