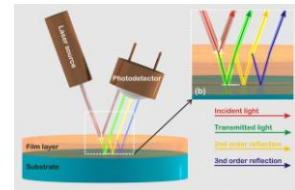


ThetaMetrisis APPLICATION NOTE #008

Control of Tartaric Sulfuric Acid Anodizing (TSA) – Anodic coating characterization by WLRS



Goal: Thickness measurement of anodic coating on Al alloys from Tartaric Sulfuric Acid anodization

Means & Methods: Aluminum-2024 alloys were prepared in an all Chrome-free process and were anodized following standard industrial tartaric sulfuric acid anodization and for various processing times. The anodic coating thickness and the refractive index were measured with an FR-Basic tool operating in the 400-800nm spectral range following the standard measurement procedure (reflectance spectrum from the sample, reference reflectance spectrum from Al mirror, dark spectrum). The fitting of the absolute reflectance spectrum with the WLRS algorithm implemented in the FR-Monitor software provides the refractive index and the thickness of the alumina layer. The measured coating thickness values were compared with values from a stylus profilometer (Ambios XP-2).

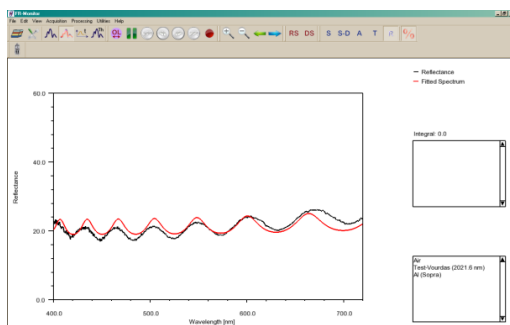


Fig. 1: Experimental and fitting reflectance spectra. Screen shot from the FR-Monitor.

Results: In Fig. 1 the experimental reflectance data (black curve) and the results from fitting (red) with WLRS algorithm from one sample are shown. In all cases reasonable agreement of the extrema positions in the experimental and fitted curves are demonstrated and the coating thickness is calculated with high accuracy. The deviation in the amplitude of the extrema between the two curves in certain cases could be attributed to increased surface roughness or coating thickness variation in the probed area. The refractive index as calculated by FR-Monitor is in the 1.45-1.55 range. In Table 1 the coating thicknesses as calculated by WLRS are compared with the profilometry values.

Sample	WLRS		Stylus Profilometer	
	Thickness	Standard deviation	Thickness	Standard deviation
S_1	1.5	0.2	1.3	0.3
S_2	2.0	0.1	2.0	0.2
S_3	2.6	0.1	2.5	0.1
S_4	3.0	0.1	2.9	0.1

Table 1: Anodic coating thickness from WLRS and profilometer. STD values have been extracted from 5 measurements (all values in Table are in micrometers-um)

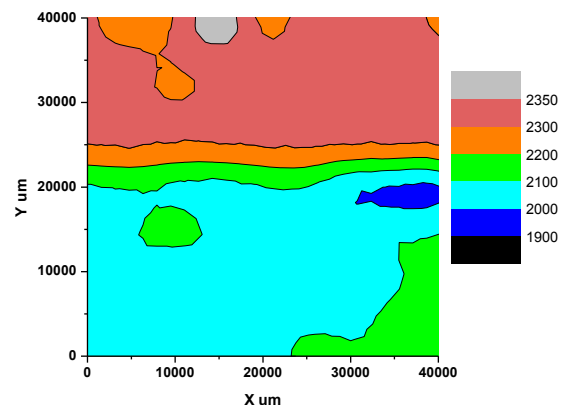


Fig. 2: Thickness (nm) mapping along a tartaric sulfuric acid anodized Aluminum 2024 alloy.

In Fig. 2 a thickness mapping (4cmX4cm) is illustrated. The thickness (scale bar in nm) varies from 2000 nm to over 2350 nm. A clear thickness variation, seen at 20000 um (2 cm) in the Y axis is observed (intentionally fabricated during anodization) that could not be detected using standard thickness measurement techniques.

Conclusions: WLRS is an accurate and powerful methodology for the non-contact, non-destructive, fast measurement of Anodic coating thickness measurement on Al alloys from tartaric sulfuric acid anodization, or relevant anodizing methodologies.