Detection of Surface Oxide Layers

Metal surfaces may undergo oxidation for a variety of reasons. In some cases, such as anodization, the oxidation process is carefully controlled so as to impart specific properties to the metal and to prepare the metal surface for bonding or painting. In other cases, such as in corrosion, the oxidation process of metals is unwanted and is a result of exposure to temperature and humidity conditions as a function of time. Moreover, impurities in the metal surface can catalyze and accelerate unwanted oxidative processes.

In applications where a primer or paint is applied to the metal surface, it is very important that the presence (or lack of) an oxide coating is known as well as the thickness of the oxide coating determined. The ability of paint or primer to adhere properly to the metal surface can be a function of the controlling the thickness and amount of the oxide coating on the metal surface. This in turn affects the long term durability of the protected surface.

FTIR spectroscopy with Exoscan has been shown to be effective at detecting oxide coatings as well as determining the thickness of the coating. The metal surface below the oxide layer is typically reflective and thus Exoscan, equipped with its external reflectance sampling device, can not only detect the metal oxide bonds but also provide information about the thickness of the coating. For example, in the spectrum of titanium sheets, it is possible to observe the anatase (Ti-O) bond using the Exoscan system. As an example, the Exoscan has been used to evaluate the coating of titanium turbine blades. One blade showed a visible scale effect. As is shown in Figure 1, the blade with the scale contained a thicker titanium oxide coating than an acceptable blade. Knowledge of the difference in oxide thickness helps the user to troubleshoot the differences in the physical appearance. In addition to the standard reflectance sample interface, a grazing angle sample interface (patent pending) allows for a longer path length through the oxide coating providing near monolayer limits of detection.

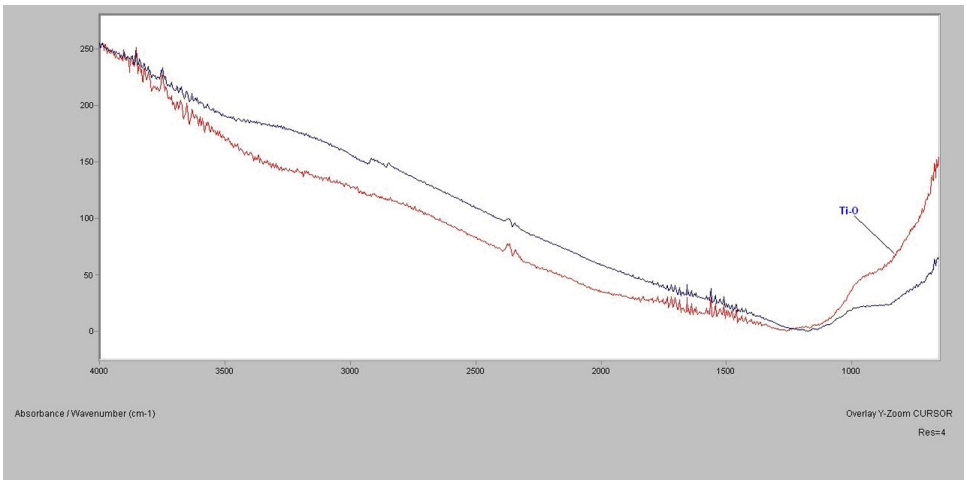

Figure 1 – Infrared spectra of titanium turbine blades showing a difference in titanium oxide thickness which lead to a visible scaling of the blade.

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