B71 In Situ Identification of Nickel Titanate and Chrome Titanate in Automotive Paints Using Extended Range FT-IR Spectroscopy (4000-220cm-1) and XRF Spectrometry

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After attending this presentation, attendees should be able to identify two inorganic pigments, Nickel Titanate and Chrome Titanate, which are used in automotive paints. This can be usefully for both identification of automotive paints and for distinguishing between finishes having similar colors.

This presentation will impact the forensic community and/or humanity by assisting forensic paint examiners who are fully utilizing infrared spectroscopy in their analyses (that is, those examiners who make an effort to identify the binders and pigments in their paint samples based on the characteristic absorptions of these components, as opposed to those using infrared spectrum in a strictly comparative mode without regard to the paint composition).

The identification, analysis, and occurrence in U.S. automobile original finishes (1974 to 1989) of Nickel Titanate and Chrome Titanate are described in this presentation. These two inorganic pigments have lemon yellow and golden yellow-orange hues, respectively. The titanate pigments are based on the rutile (titanium dioxide) structure and there are only minor differences between the infrared absorptions of rutile and the titanates. Titanate pigment absorptions in paint spectra can thus be easily mistaken for those of rutile. However, each of the titanates contains two elements in addition to titanium that can serve to distinguish those using elemental analyses. Extended range FT-IR (4000 – 220 cm^{-1}) and XRF instruments were thus used in combination for the in situ analysis of the titanates.

In addition to titanium, nickel, and antimony, the three main detectable elements comprising Nickel Titanate, all of the commercial products of this pigment that were examined by XRF (using a tin secondary target) contained impurities of zirconium, niobium, and usually lead. These elements were also detected in most of the paints in which Nickel Titanate was identified, as well as in the Chrome Titanate pigments and paints. The relative levels of these elements vary, particularly the zirconium to niobium ratio, and this can serve to distinguish further paints containing a specific titanate pigment. These impurities arise primarily from the ores that are used to produce anatase, which in turn is used to produce the titanates. Additional zirconium may result from degradation of the dispersion beads that are used in the man- ufacture of the paint, if zirconium oxide beads are used.

Nickel Titanate is a relatively common pigment that was identified in nearly three dozen U.S. automobile yellow nonmetallic monocoats (1974 to 1989) from the Reference Collection of Automotive Paints (Collaborative Testing Services). Chrome Titanate appears to have been used in only a few yellow and orange nonmetallic monocoats. The use of the titanate pigments likely increased after this time period as they were replacements for lead chromate pigments, which were last used in a U.S. automobile original finish in the early 1990s. Titanates likely also become more common after 1989 because of the increasing prevalence of basecoat/clearcoat finishes. Heavy pigment loads are required with the titanates to achieve the vivid colors typical of many automotive finishes, and this makes it difficult to achieve a high gloss finish in a monocoat. However, this is not a problem with a basecoat/clearcoat finish.

Paint, FT-IR, XRF

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