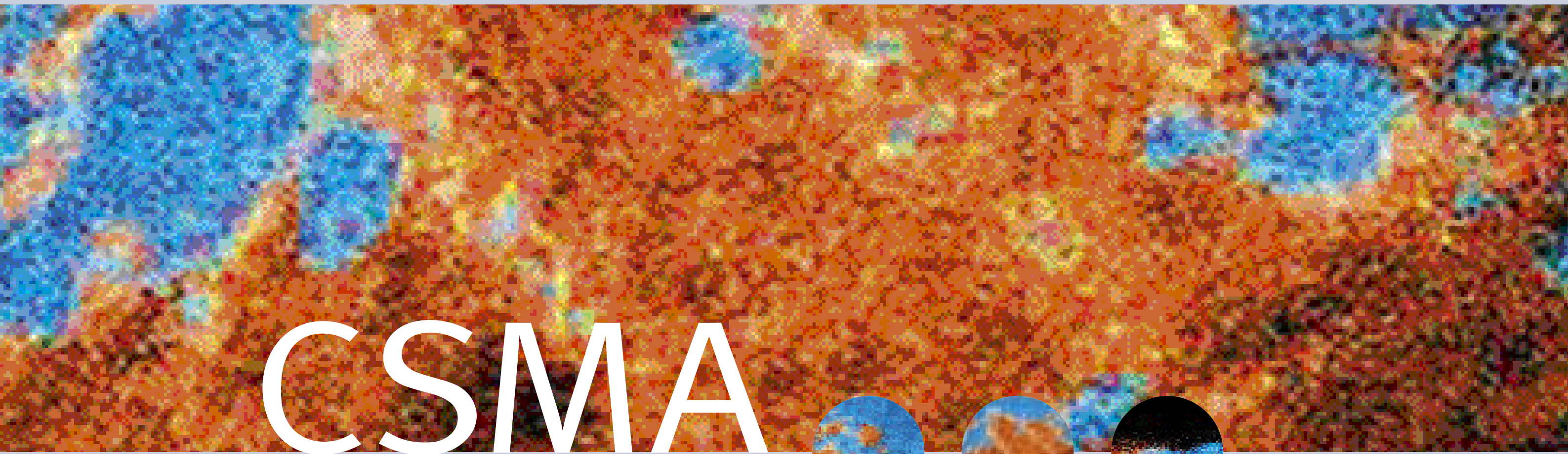
TOTAL SOLUTIONS FOR THE
LACQUER AND PAINT COATING INDUSTRY



CSMA

Many of today's lacquer and paint coatings are complex multi-component formulations, designed for decorative, protective and functional applications. Surface analysis methods are important for the study of such coatings, including:

- Investigation of lacquer and paint delamination (adhesive and cohesive failures).
- Analysis of other coating defects including craters, particulates and changes in cosmetic appearance (bloom, loss of gloss).
- Evaluation of coating integrity e.g. uniformity and distribution, thickness, homogeneity (phase separation, additive segregation).

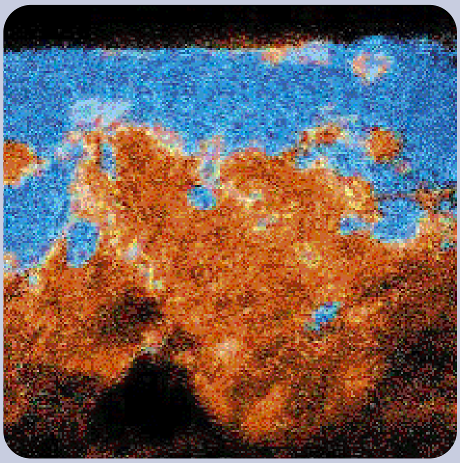
BENEFITS TO CUSTOMER

- Cost effective - one day of analysis can often identify the coating problem
- Rapid information - clear decisions can be made to take remedial action to improve processes
- Validation of new processes by comparison to predicted models
- Assessment of competitors' products - reverse engineering

CASE STUDY ONE

Lacquer/Varnish Coatings on Wood

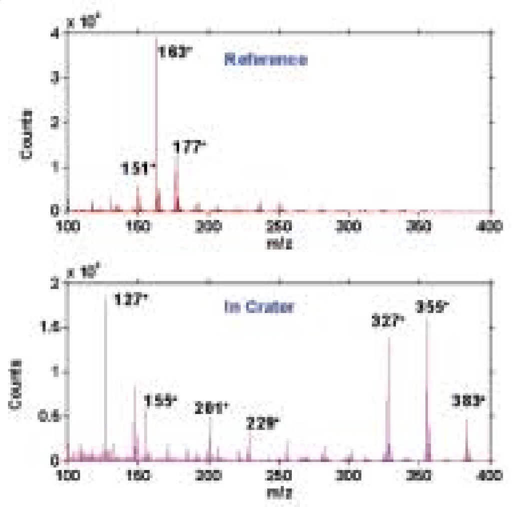
Depth profiling SIMS and/or SIMS imaging can give an assessment of the effectiveness of different lacquer formulations for varnishing different woods. This is illustrated by a two-colour overlay SIMS image of a varnished wood cross-section which shows the surface film structure and penetration of a UV-lacquer (blue; using a lacquer-specific signal in the SIMS mass spectrum) into a wood (brown; using a wood-specific signal in the SIMS mass spectrum).



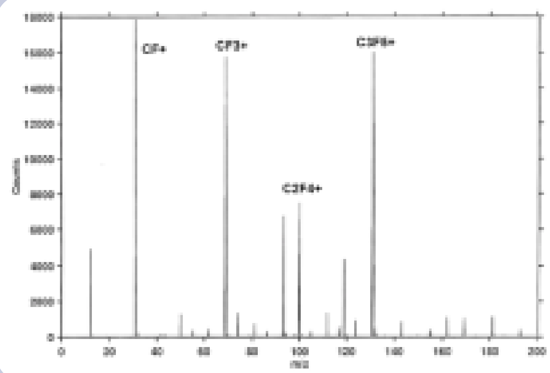
Crater Defects in Lacquer and Paint Coatings

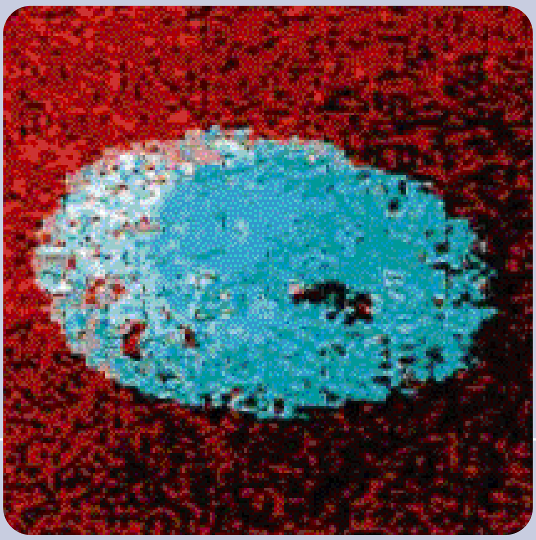
Craters were visible in a melamine-based lacquer coating on a metallised foil. ToF-SIMS was used to analyse a crater with reference to non-cratered lacquer material. The results revealed high levels of caprylate and caprate-based esters of glycerol within the crater. Diagnostic signals for this material include m/z $127^+/155^+$ ($C_nH_{2n+1}CO^+$) and m/z $327^+/355^+/383^+$ ($C_nH_{2n+1}C(=O)O\text{-}CH_2\text{-}CH[O(O=C)C_nH_{2n+1}]\text{-}CH_2^+$) (where n is a mixture of 7 and 9), readily identifiable using the molecular specificity of ToF-SIMS. Glyceride esters can be used in lubricant formulations and the source of this contamination was the coating equipment.

Craters and other defects have also been observed in automotive coatings, illustrating the necessity for stringent cleanliness specifications during the painting process. ToF-SIMS is used routinely to investigate these (see example below).



ToF-SIMS data (right), acquired within a crater in an automotive coating, showed that a fluorocarbon contaminant had caused localised de-wetting of the surface during paint application, resulting in crater formation.





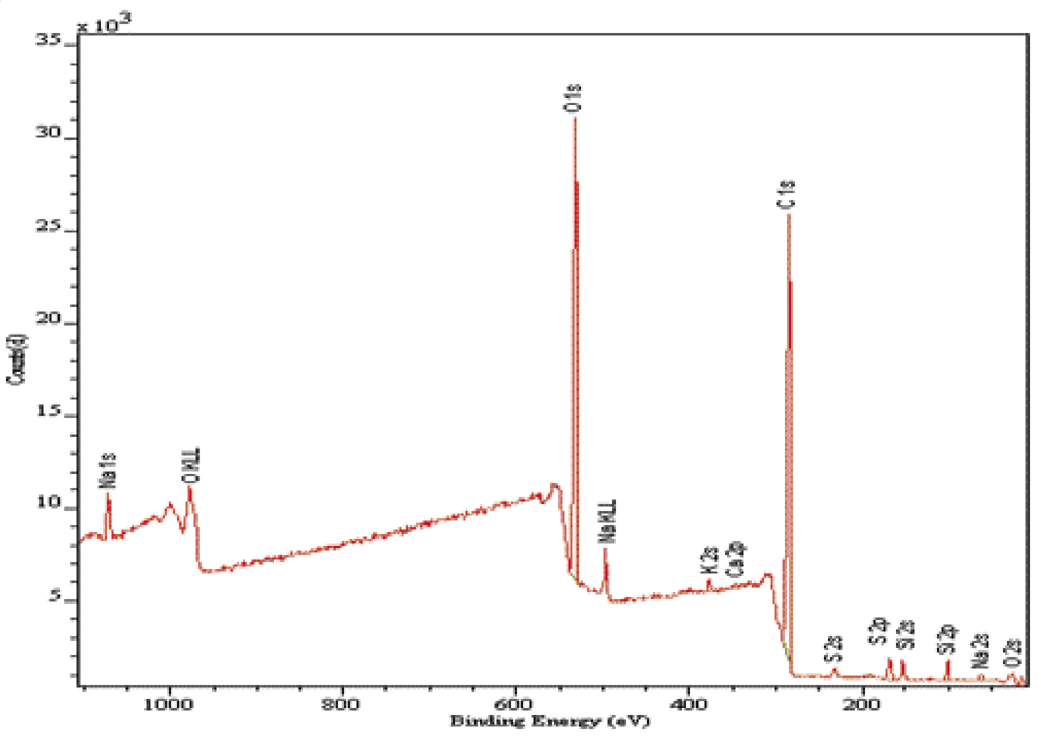
The two-colour overlay ToF-SIMS image (left) shows an intense fluorine signal in the de-wetted area (cyan), associated with the fluorocarbon contaminant. Organic species from the paint layer are shown in red.

Evaluation of Coating Integrity

As a quantitative method, XPS is a valuable tool for the determination of coating uniformity and thickness. This is demonstrated for a functional siloxane coating on a polymer substrate where multi-area XPS analysis (supported by SIMS imaging) showed a reasonably homogeneous siloxane distribution over the polymer surface.

SURFACE COMPOSITIONS IN ATOMIC % DERIVED FROM THE XPS SPECTRA

Element	Area 1	Area 2	Area 3
Carbon	65.9 ± 0.3	66.1 ± 0.3	65.0 ± 0.4
Oxygen	26.0 ± 0.2	25.9 ± 0.2	26.2 ± 0.2
Silicon	2.5 ± 0.1	2.7 ± 0.1	2.8 ± 0.2
Sulfur	1.4 ± 0.1	1.1 ± 0.1	1.2 ± 0.1
Sodium	2.1 ± 0.2	1.8 ± 0.2	2.3 ± 0.3
Potassium	1.3 ± 0.2	0.9 ± 0.2	1.3 ± 0.3
Calcium	0.1 ± 0.1	0.4 ± 0.1	0.3 ± 0.1
Chlorine	0.07 ± 0.02	0.13 ± 0.04	0.19 ± 0.04
Boron	0.7 ± 0.2	1.0 ± 0.2	0.7 ± 0.3
Nitrogen	Not detected	Not detected	Not detected



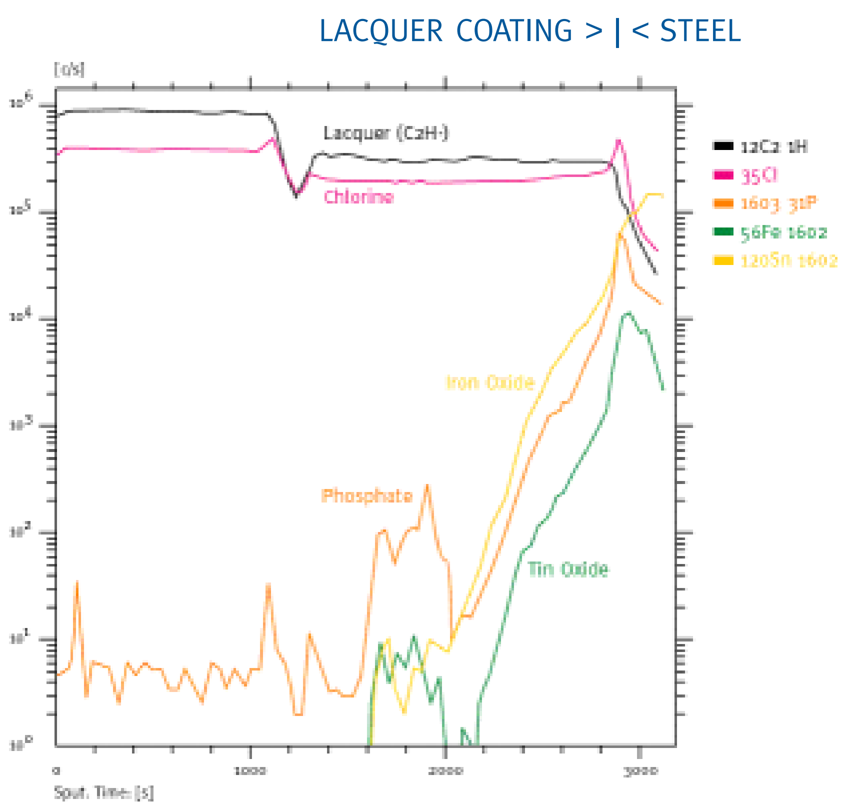
Typical XPS survey spectrum from functional siloxane coating on a polymer substrate

CASE STUDY FIVE

Failure of Beverage Can Coatings

SIMS depth profiling was used to study the failure of beverage can coatings on long term shelf storage. The locus of failure was believed to have occurred at the lacquer coating / can wall interface with a suspected corrosion mechanism involved.

SIMS profiles through the lacquer coating and into the steel can substrate revealed the presence of high levels of chlorine at the lacquer/steel interface on cans with poor long-term performance (see below). In contrast, good cans had relatively low levels of chlorine present. In combination with other analyses, the results revealed a corrosion mechanism involving transport of chlorine to potential corrosion sites during storage.



CSMA provides a complete surface analysis service to industry to accommodate every level of demand:

- rapid turnaround analysis (24 hours)
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- litigation and expert witnesses
- training courses
- reverse engineering and competitor analysis
- materials and product development
- patent registration / infringement

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