APPLICATION NOTE

Using the MiniSIMS with FTIR to Identify Surface Contamination

Mini SIMS

Superior surface sensitivity and inorganic analysis by MiniSIMS complement the information available from FTIR

- Augmentation of FTIR Data by MiniSIMS Analysis
- Identification of both Elemental and Organic Components
- Higher Surface Specificity using MiniSIMS

Organic surface contamination is a problem in many industries. However, it is often difficult to identify the exact source of a problematic organic layer. Rather than rely on a single analysis technique, we report here on the use of a combination of two complementary techniques (FTIR and SIMS) to give detailed information about the identity of an organic contaminant on a component surface.

Fourier Transform Infra-Red (FTIR) spectroscopy is a well-used technique to identify organic chemicals, and it has the ability to identify the functional groups present. However, the analysis spot and the sampling depth are significantly larger. An organic contaminant upon an organic surface is therefore often difficult to resolve.

Secondary Ion Mass Spectrometry (SIMS) is a much more surface specific analysis technique, giving a higher sensitivity to surface contamination. As SIMS is based on a mass spectrometry analysis, there is rich structural information available from the molecule rather than just the identification of functional groups. Unlike FTIR, SIMS can also obtain both organic and inorganic information from a sample.

The Millbrook MiniSIMS is a fast and cost-effective way of obtaining the required SIMS data without the use of an expensive contract analysis facility using conventional instrumentation.

See overleaf for more detailed information.

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The Fourier transform infra-red data was obtained by reflection from the surface of the component. In this case the component was not flat and so the signal is quite weak. The FTIR spectrum (figure 1) shows that the surface of the component is contaminated with a saturated hydrocarbon based compound with the oxygen present as C-O functionality.

To obtain further information about the organic species of interest, static SIMS data was also obtained from the component. The spectra were obtained in 30 seconds each and are representative of the extreme nanometre of the sample surface. Note that analysis of curved or topographically rough surfaces has little effect upon the quality of the data obtained using the MiniSIMS.

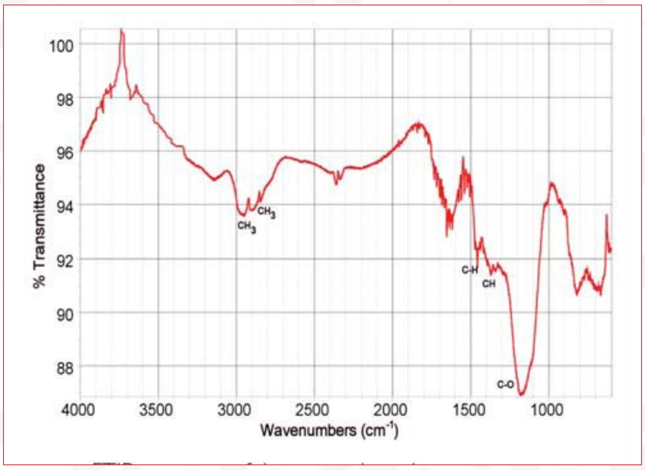

Figure (1) FTIR SPECTRUM OF CONTAMINATED COMPONENT

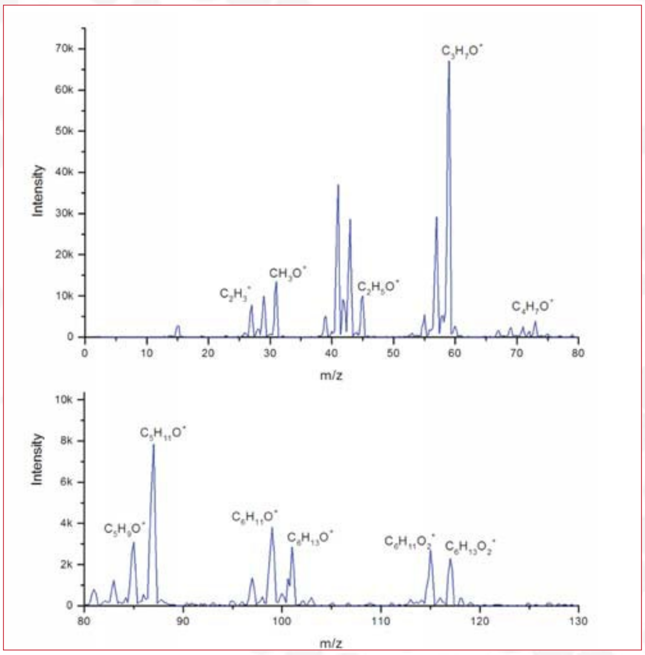

Figure (2a) POSITIVE SIMS SPECTRUM OF CONTAMINATED COMPONENT

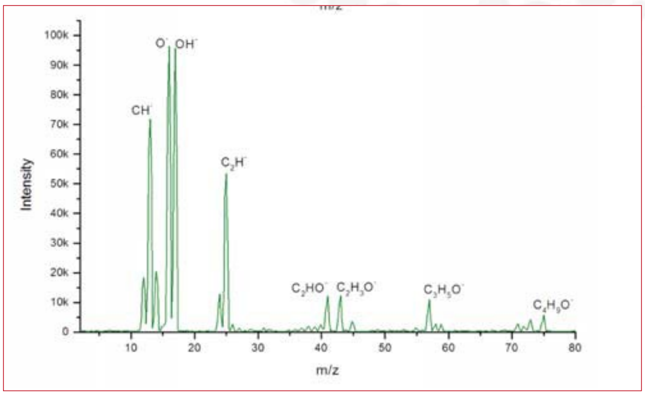

Figure (2b) NEGATIVE SIMS SPECTRUM OF CONTAMINATED COMPONENT

The SIMS spectra obtained in both positive (figure 2a) and negative (figure 2b) ion mode are shown to the left. The data reflects the presence of hydrocarbon and the C-O functionality, but provides further information regarding the composition of the organic layer. There is clear evidence for ether functional groups from methyl- to hexyl- variants. This suggests that the contamination is a crude mixture rather than a refined single component material.

The data also suggests that as the peak at m/z = 59^+, assigned as $C_3H_7O^+$, is the largest in the spectrum the major component can be identified as a propyl-ether derivative. This information is not available from the FTIR technique. The negative ion mode confirms the presence of oxygen at the surface and gives further evidence for the hydrocarbon based ether derivatives. Comparison with SIMS library spectra identifies this industrial organic chemical as an electrical contact treatment oil (Electrolube 2X) originating from another stage in the manufacturing process.

The use of two (or more) techniques to tackle a problem such as this ensures that a full picture is obtained of the nature of a particular issue. The combination of FTIR and SIMS gives a powerful advantage in characterising surface organic contamination, not just detecting its presence but also allowing rapid identification of the molecules involved.

FTIR analysis courtesy of Dr. S Jenkins, LPD Labservices, +44(0)1254 507377