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XPS Analysis of a Surface Contamination on a Steel Sample

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Key Words

- **K-Alpha**
- **Imaging**
- **Metals**
- **Steel**
- **Surface Analysis**
- **Surface Contamination**
- **XPS**

The Thermo Scientific K-Alpha XPS was used to identify a surface contamination found on the surface of a stainless steel sample.

Introduction

Ensuring a surface is free from contaminants is extremely important in guaranteeing that materials such as steel meet their desired performance specification. Surface contamination of steel can result in problems such as adhesion failure and contact bonding problems when steel components are used in manufacturing. Surface contaminants can also result in an "unsatisfactory" appearance for many steel finished products such as ovens and other domestic appliances. In addition, surface contaminants are often the source of cross-contamination, corrosion and electrical contact problems. Many of these surface contamination issues are difficult to detect during or after production of manufactured goods using steel parts. By using a surface specific analysis technique, the cleanliness of the surfaces can be validated at each stage of the manufacturing process. Post manufacturing analysis of non-performing parts can also be carried out to determine failure mode. X-ray Photoelectron Spectroscopy (XPS) is the ideal analytical method for these applications, combining quantitative elemental and chemical information with extreme surface sensitivity.

Experimental and Results

An area (3.7 mm × 4.8 mm) of a stainless steel surface was investigated with Thermo Scientific K-Alpha XPS (Figure 1). Several elemental maps were acquired by scanning the sample stage under the X-ray spot and collecting 128-channel snapshot spectra at each point.

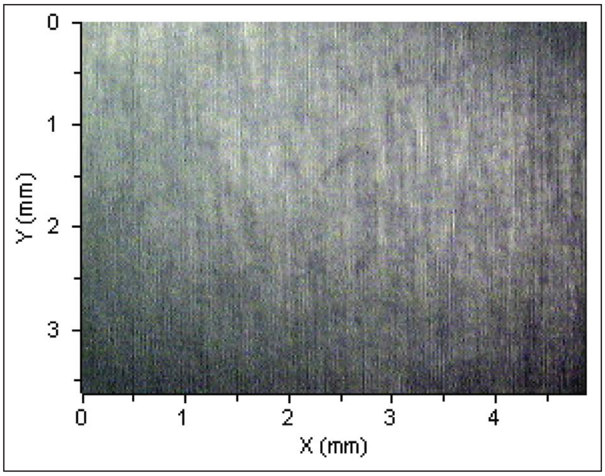

Figure 1: Optical view of the analysed area

Figure 2 shows the atomic concentration maps of the analyzed area. The maps show clearly the difference between clean stainless steel and the contaminated areas. The contamination was identified to be an organic residue on the surface.

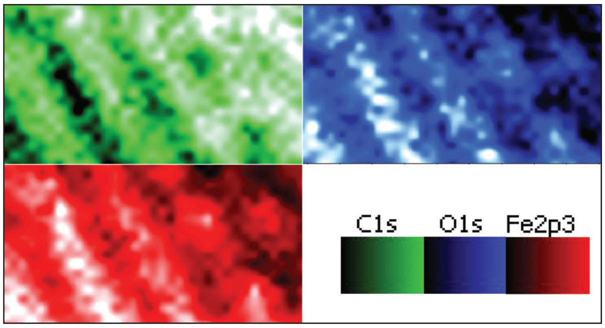

Figure 2: Atomic concentration maps of the stainless steel surface

Figure 3 shows the atomic concentration maps overlaid on to the optical image of the sample. The Thermo Scientific Avantage datasystem, an integrated software solution for all of our surface analysis systems, acquires the optical image for the mapped area and aligns the elemental maps with the optical image automatically. Because the Avantage datasystem also stores the coordinates of the map, it is possible to select any point from the analyzed area and acquire more data from that point if necessary.

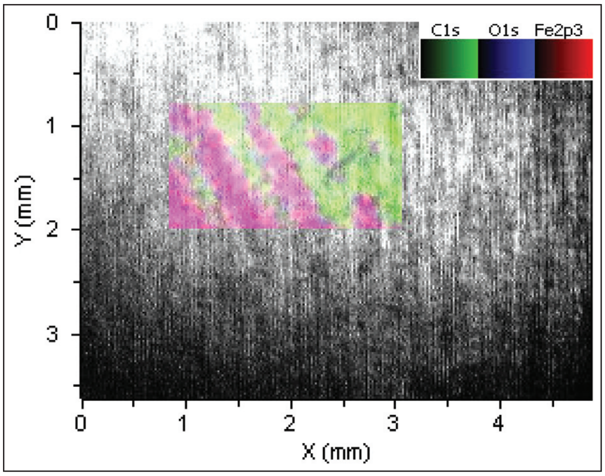

Figure 3: Atomic concentration maps on top of the optical image of the sample

Summary

By acquiring elemental maps with the Thermo Scientific K-Alpha XPS the spatial distribution and chemical nature of the contamination on the stainless steel sample was identified. The contamination was shown to be an organic residue. Due to its high surface sensitivity XPS has been shown to be a powerful technique for the identification and mapping of surface contaminants, even when present in low concentrations.

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