APPLICATION NOTE

Analysis of a wound dressing

The Thermo Scientific ESCALAB Xi+ X-ray Photoelectron Spectrometer (XPS) Microprobe was used to measure the silver distribution in a wound dressing.

This analysis requires the ability to produce images over a large area and at high resolution over a small area. The quantity of silver present in these dressings is small so high sensitivity is essential.

Introduction

Wound dressings that contain silver are now widely used to minimize the occurrence of bacterial infection in certain types of wounds. The usefulness of these dressings depends upon the chemical and physical nature of the silver, which includes the way in which the silver is distributed over the dressing.

The spectroscopic imaging capability in the Thermo Scientific™ ESCALAB™ Xi+ X-ray Photoelectron Spectrometer (XPS) Microprobe makes this an ideal instrument for assessing the quality of this type of material. It can be used, for example, to determine the distribution of the silver within the dressing on both a large and a small scale. Large-scale spectroscopic imaging can be accomplished by stage mapping, and small-scale, high-resolution imaging makes use of the parallel imaging capability of the ESCALAB Xi+ XPS Microprobe. The concentration of silver in these materials is very low, requiring the high sensitivity available from the ESCALAB Xi+ XPS Microprobe.

Experiment

Figure 1 shows the optical view of the sample of the dressing in the analysis position. The woven nature of the sample is clear in this image.

A set of large-area spectrum images was acquired from this sample. This was accomplished by setting the monochromator spot size to 200 µm and scanning the sample under the monochromator beam. A spectrum was acquired for Ag3d and C1s at each pixel.

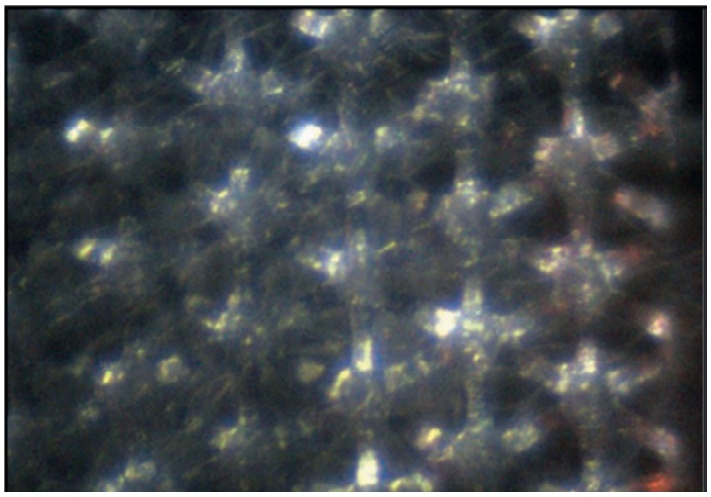

Figure 1: Optical view of the wound dressing.

Using the large-area images, a position was defined for small-area, high-resolution, parallel imaging. This method ensures that the position for the high-resolution map can be selected quickly and accurately. This is a powerful capability provided by the Thermo Scientific Avantage Data System.

For the high-resolution measurements, the parallel imaging was combined with spectroscopic imaging. This ensures that, for each element, there was a spectrum acquired at each pixel of the image, enabling accurate quantification of the images.

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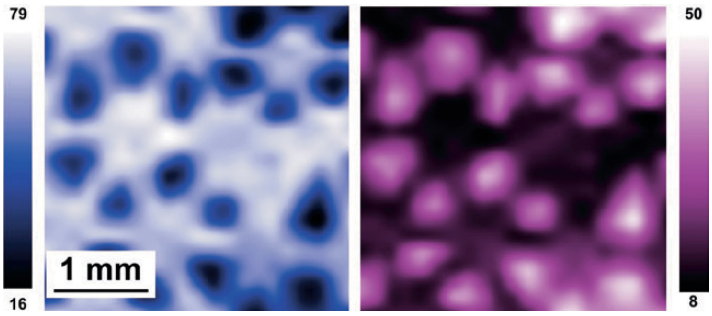

Figure 2: Quantified chemical state images from the wound dressing. The image on the left shows the distribution of C-C bonds, and the image on the right shows the distribution of the C-O bonds. The intensity scale is calibrated in atomic percent.

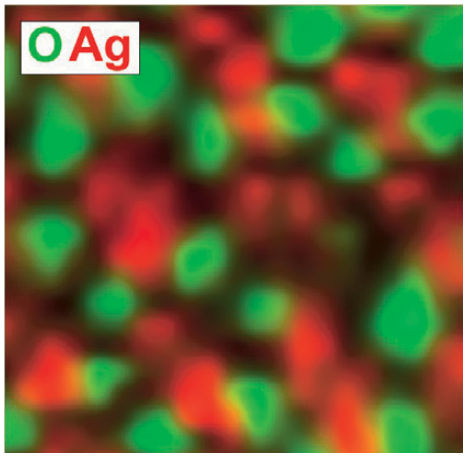

Figure 3: An overlay of the quantified Ag 3d and O 1s images from the same area as that shown in Figure 2.

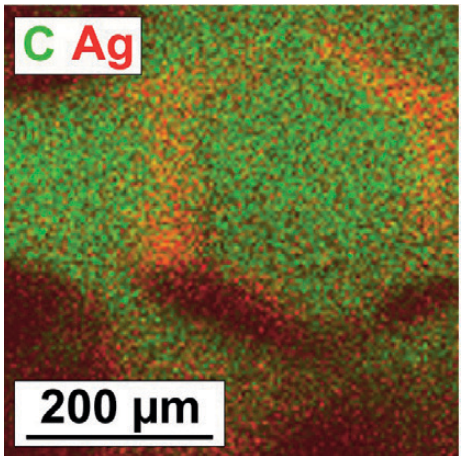

Figure 4: An overlay of the high-resolution images from C 1s and Ag 3d acquired using the parallel imaging mode.

Results

Figure 2 shows the quantified images from the large-area mapping measurement from the C 1s peaks associated with C-C and C-O. Figure 3 is an overlay of quantified images of O1s and Ag3d from the same area as the images in Figure 2. Comparison of these images shows that the silver is associated with the areas of the dressing possessing a low concentration of oxygen.

These large-area maps can then be used to define the analysis position for the small-area, high-resolution, parallel imaging. Figure 4 shows an overlay of C1s and Ag3d parallel images clearly showing the distribution of silver in the dressing. This shows that the distribution of the silver is well-defined on a microscopic scale.

Summary

The ESCALAB Xi$^+$ XPS Microprobe has been successfully used to map quantitatively the low concentration of silver on a wound dressing. The results reveal that the distribution of silver is well defined on both a millimeter and a micrometer scale.

The ability to select the position of the high-resolution images directly from the large-area image is a rapid and accurate method for producing these quantitative images.