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Analyzing Contact Lens Samples

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Key Words

- K-Alpha
- XPS
- Characterization
- Contact Lens
- Surface Analysis

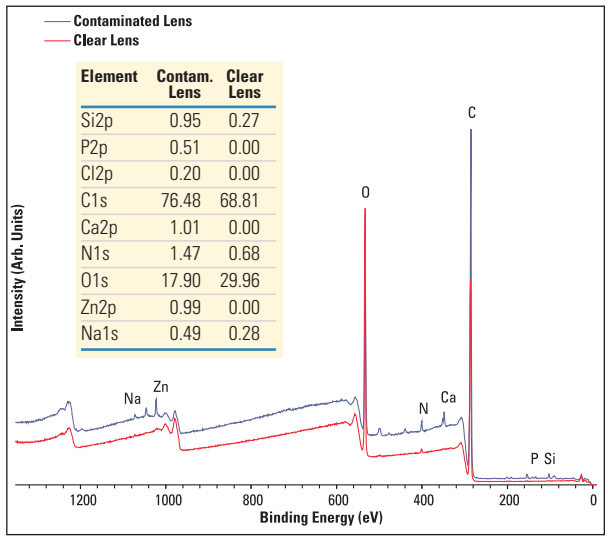
The Thermo Scientific K-Alpha was used to analyze the elemental and chemical composition of a set of contact lens samples. The Avantage Data System can be programmed to characterize a large batch of samples for routine analysis and output the results in simple format.

Introduction

The design of the contact lens is crucial for its usability. The lenses are in close contact with the eye, sometimes for extended periods of time, so they have to be safe and comfortable to use. Contact lenses have been subjected to different kinds of surface treatments to improve their surface properties with the intent to make the surfaces more hydrophilic, deposit resistant or scratch resistant. Optimization of the design of the contact lens requires the characterization of the surface. X-ray Photoelectron Spectroscopy (XPS) is the ideal analytical method for investigating elemental and chemical composition of the surface. It can also provide information about the coating layers (coating uniformity and thickness) and the interfacial chemistry. In conjunction with automated processing, it can be used to investigate coating thickness across a group of lenses.

Experimental and Results

A set of contact lens samples was analyzed with the K-Alpha XPS. The simple turn-key charge compensation system of K-Alpha was used during the analysis to maintain stable analysis conditions. Figure 1 shows survey scan spectra of two lenses. The wide scan survey spectrum allows quantitative elemental characterization of the surface.



Element	Contam. Lens	Clear Lens
Si2p	0.95	0.27
P2p	0.51	0.00
Cl2p	0.20	0.00
C1s	76.48	68.81
Ca2p	1.01	0.00
N1s	1.47	0.68
O1s	17.90	29.96
Zn2p	0.99	0.00
Na1s	0.49	0.28

Figure 1: Survey spectra of two contact lenses

The chemical state of the element can be studied by a narrow scan region spectrum. With this information, it is possible to confirm the treatments or additives used on the lens have been successful, or identify a source of contamination. Figure 2 shows the carbon chemical states identified at the surface on a contact lens.

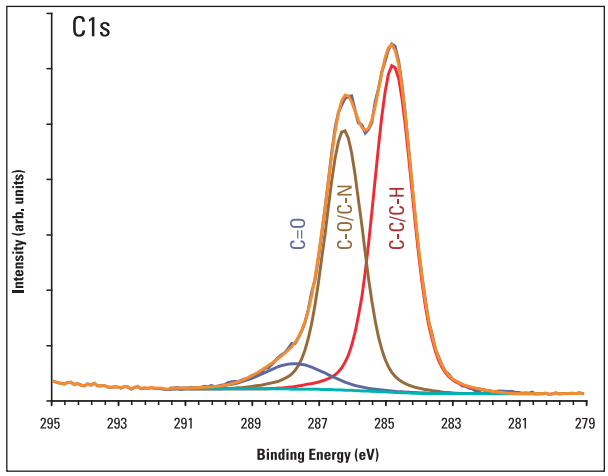


Figure 2: The chemical states of carbon detected at the surface of a contact lens

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Figure 3 shows a depth profile of a contact lens. The contact lens has been profiled using low energy argon ions. The coating layer has been highlighted with gray. The chemical integrity of the sample is maintained and chemical changes can be traced as a function of depth. Using low energy ion beam K-Alpha is able to maintain the polymer chemistry even during profiling.

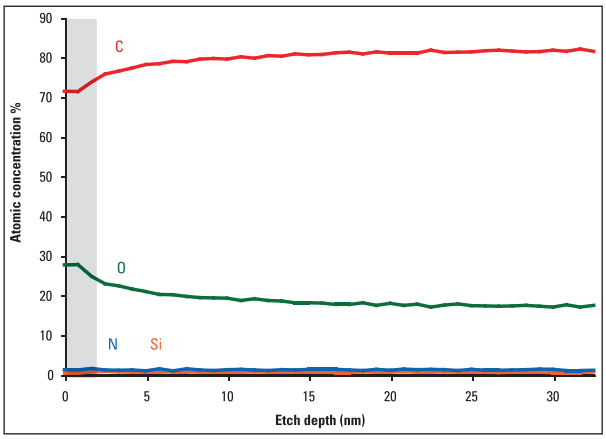

Figure 3: A depth profile of a contact lens using 200 eV argon ions. The coating layer has been highlighted in grey.

Experiment Recipe and Batch Processing

With K-Alpha, expertly designed experimental recipes can be developed to be used by multiple users. This is particularly useful when analyzing large sets of samples several times for the same information. The user only needs to select the required recipe and define the sample analysis positions. The Avantage Data System allows automation, from data collection to processing, enabling a series of analyses to be exported to a spreadsheet and facilitating batch processing of sample sets. An example of the experiment recipe is shown on Figure 4 and Figure 5, demonstrating the output after the automated processing.

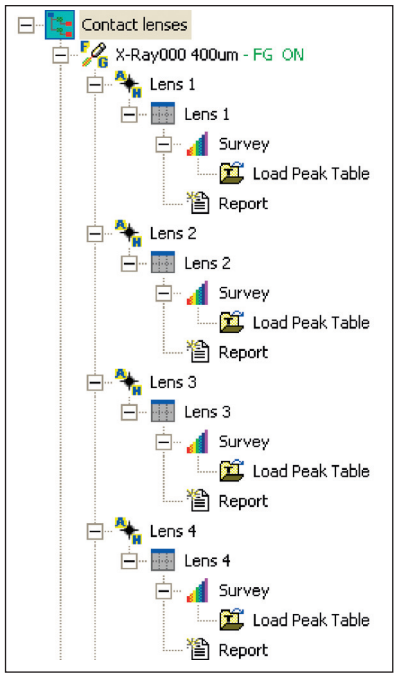

Figure 4: An example of an experiment recipe for batch processing

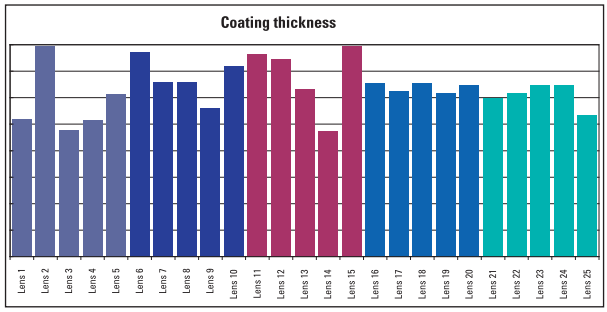

Figure 5: An example of batch processing output for a set of contact lenses

Summary

With K-Alpha and the Avantage Data System, this application note showed how large sample sets of contact lenses can be characterized routinely for the elemental and chemical composition of the surface. Depth profiling can be used to provide information about the composition and uniformity of the coating layer.

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