KRATOS ANALYTICAL
A SHIMADZU GROUP COMPANY

XPS of Medical Textiles

Keywords
spectroscopy, imaging, medical textiles, implants, plasma treatment

Application Note MO404(1)
Further application/technical notes are available online at:
www.kratos.com

Evaluation of Anti-Adhesive Coatings on Medical Textiles by XPS

XPS is a well-established method for the chemical characterisation of material surfaces. Key developments in recent years, including imaging, have resulted in a wider range of applications. Manufacturers and suppliers of both commercial and technical textiles are now exploiting XPS as an ideal tool to aid the development and optimisation of the types of surface coating/treatment demanded by industry and consumers.

Plasma Treatment of Medical textiles

Polymer meshes, such as polypropylene and polyester, are used for the surgical repair of hernias and other soft tissue defects. Although the use of mesh material has led to a widely accepted improvement in this kind of surgery, their implantation can be associated with serious infection rates. In order to reduce the infection rates of such meshes, their surface properties have to be improved.

The application of low pressure and atmospheric pressure plasmas for the functionalisation and coating of textile surfaces is growing in importance. The key areas of plasma process activity for new textile products include the production of repellent surfaces to prevent/limit the adhesion of biofilms/bacteria e.g. for surgical and hygiene applications.

Here we illustrate the usefulness of XPS for investigating the integrity of a PEG (polyethylene glycol) plasma coating on a PP (polypropylene) mesh.

XPS of PEG Coated PP Mesh

The PEG coating can be detected by XPS spectroscopy in a survey (elemental) spectrum as the presence of oxygen (An example of this is shown in figure 1). Only carbon is detected from an untreated PP surface.

Kratos Analytical Ltd. UK
Wharfside, Trafford Wharf Road, Manchester M17 1GP
Phone: +44 161 888 4400 Fax. +44 161 888 4402 www.kratos.com

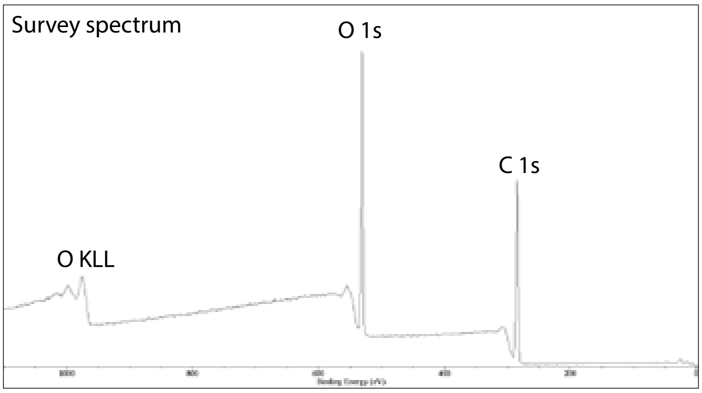

Figure 1: XPS survey spectrum from PEG-coated PP.

High resolution C 1s spectra allow examination of the chemical states present and indicate the extent of the surface treatment.

The C-O rich PEG coating dominates for meshes with good PEG coverage. Figure 2a shows a large C-O component at a binding energy of 286.5 eV. This is in contrast with the significantly higher C-C component, characteristic of the PP mesh, for lower coating coverages. Figure 2b shows a much higher C-C component at a binding energy of 285.0 eV.

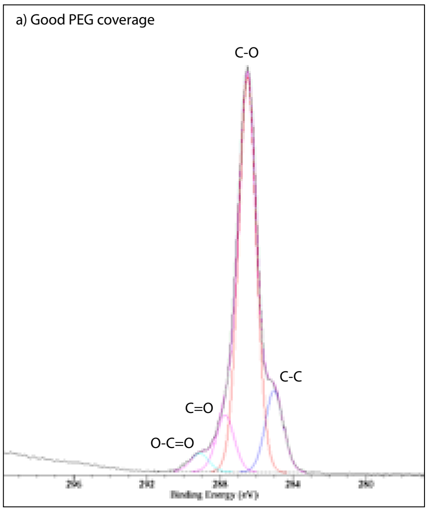

Figure 2a: C 1s XPS spectrum from PP mesh with good PEG coverage.

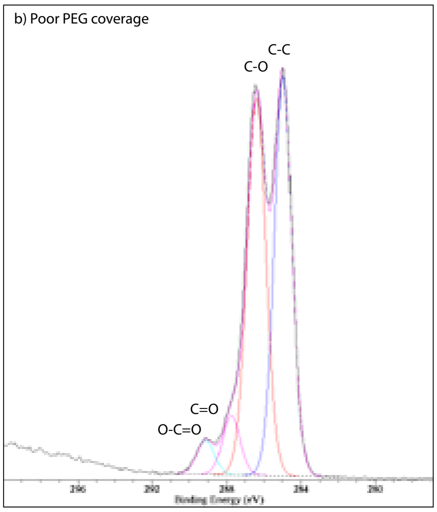

Figure 2b: C 1s XPS spectrum from PP mesh with poor PEG coverage.

In conjunction with the spectroscopy, XPS imaging is important for assessing coating coverage. This is illustrated in figure 3 for a region of plasma-treated mesh where the PEG-based coating is incomplete and the PP mesh can be detected.

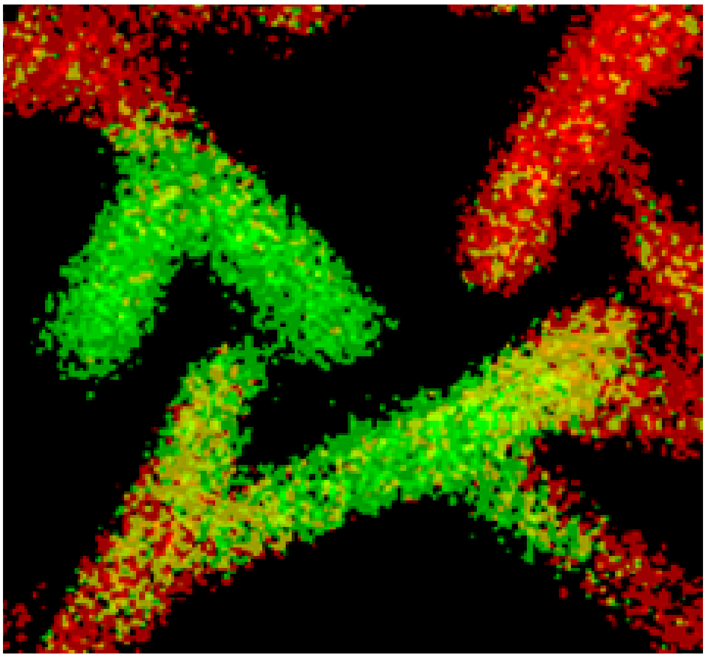

Figure 3: Overlay of C-C and C-OI chemical state images from a PEG-based coating on a PP mesh. Green regions = good coating coverage (C-O), red regions = poor coating coverage (C-C). Image dimensions = 0.8 x 0.8 mm.

The PEG coating and integrity can be quantified as a function of the plasma treatment parameters. Therefore XPS can help to optimise the PEG coating for maximum anti-adhesive properties. The technique can be further used to assess, for example, the effects of sterilisation (i.e. autoclaving, gamma irradiation, ethylene-oxide) or packaging/storage on the PEG coating.

Conclusion

The coating of surgical meshes is a major challenge for plasma technologists and XPS is playing an important role in the developments of this technology.

Related documents available online:

Sputter depth profiling of cross-linked plasma polymers by Ar gas clusters

Applications note MO393

Click to download

Plasma treated textiles

Applications note MO431

Click to download

KRATOS ANALYTICAL
A SHIMADZU GROUP COMPANY

Wharfside, Trafford Wharf Road,
Manchester M17 1GP
Phone: +44 161 888 4400
Fax. +44 161 888 4402
www.kratos.com