Distinguishing Spin Cast Polymers with XPS

Problem

Two thin (0.5µm) polymer films were spun cast onto aluminium foil to demonstrate the capabilities of XPS to distinguish the subtle differences between these two similar organic materials.

The two polymers chosen were PMMA and PEMA which only differ by one CH2 group on the side chain of the repeat unit as shown below.

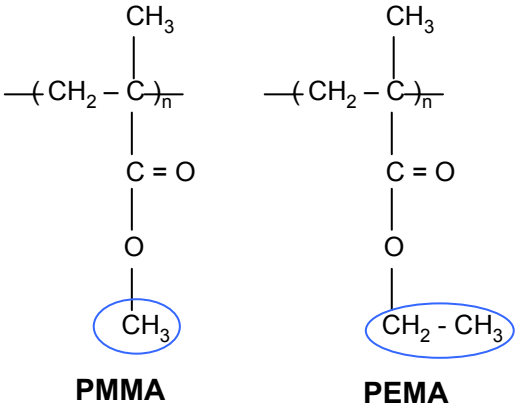


Fig.1. Polymer repeat units of Poly(methyl methacrylate) – PMMA and Poly(ethyl methacrylate) – PEMA highlighting the differences in the organic chain.

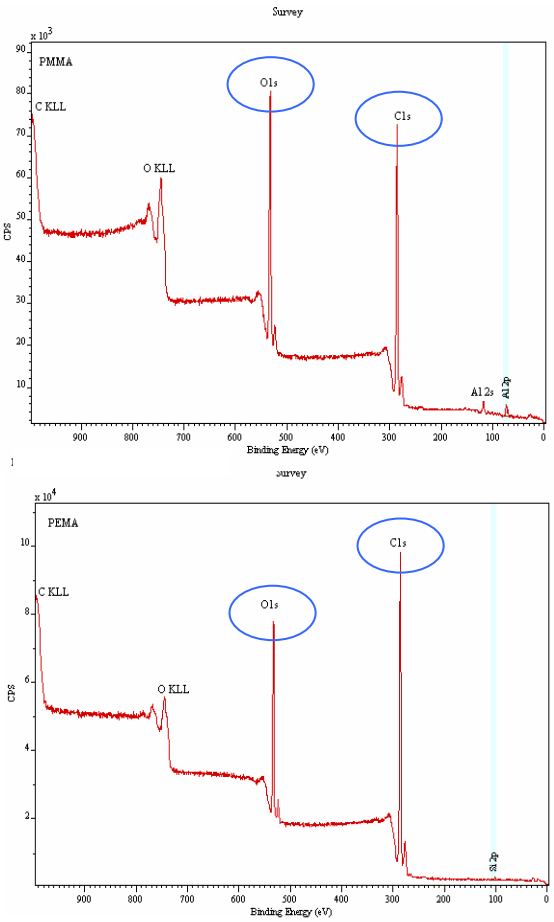
Fig.2. (Right) Comparison of the XPS survey spectra from the surfaces of the two spin cast polymers highlighting the expected difference in carbon / oxygen ratio. The areas under the peak relate to the elemental atomic concentration.

Analytical Technique Capabilities

XPS (X-ray Photoelectron Spectroscopy) is a technique which chemically analyses the top few atomic layers of a solid material. It not only permits the surface elements to be determined, but also the chemical state and atomic concentration (directly from the areas under the peaks).

XPS can be used for organic and inorganic materials. Samples can be conductors, semiconductors or non-conductors.

XPS Surface Analysis Results



(* denotes UKAS accredited test)

LPD Lab Services Limited

– a unique combination of analytical equipment, techniques, and investigative experience

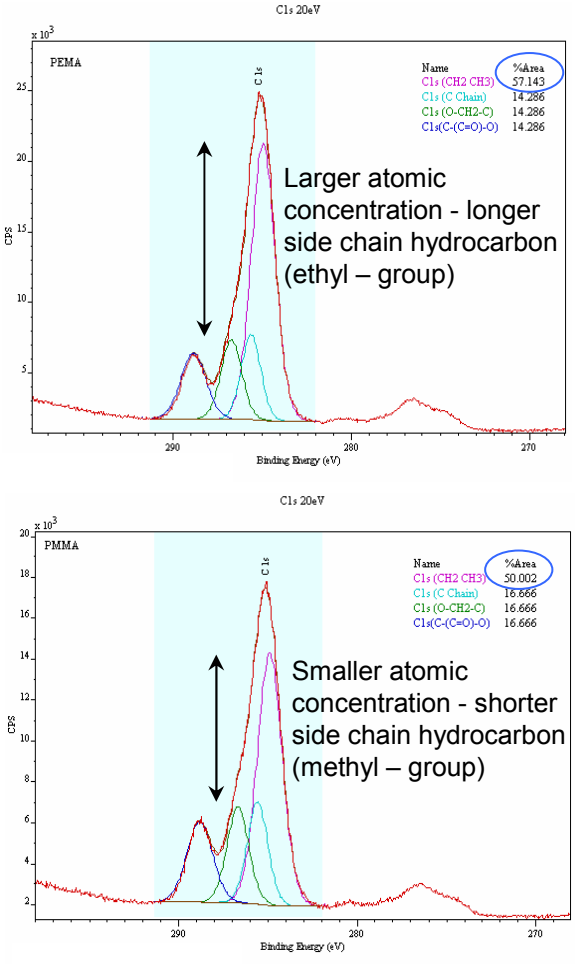


Fig.3. Comparison of the XPS Carbon 1s narrow scan spectra from the surfaces of the two spin cast polymers. The peaks have been fitted highlighting the increase in hydrocarbon component due to the hydrocarbon extended side chain on the PEMA.

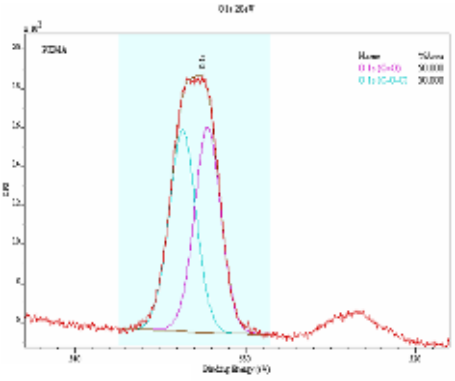


Fig.4. Example XPS Oxygen 1s narrow scan spectrum from the surface of the spin cast PMMA showing the 2 components related to the C-O-C and C=O bonding. The PEMA gave a similar spectrum.

Problem Solution and Other Capabilities

XPS has distinguished between the 2 different polymer films, both in terms of atomic concentration and chemical state, despite there only being a slight molecular difference between PMMA and PEMA.

The XPS technique can be used for both thin films and bulk polymers. Organic contaminants (oils) can also be analysed and the information used to track their root cause.

XPS coupled with peak fitting allows subtleties in differences between organics to be highlighted. It is capable, for example, of monitoring the effectiveness of Corona discharge processes industrially used to improve adhesion in packaging and labeling technology.

Contact us today

Find out how we can help solve your problems in process improvement, process control and materials analysis

LPD Lab Services
Phone: +44 (0)1254 676074
E-mail: enquiries@lpdlabservices.co.uk
Web: www.lpdlabservices.co.uk