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APPLICATION NOTE

Contact Lenses: Understanding Surface Chemistry Critical to Optimizing Design

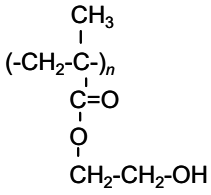
DISCUSSION

Contact lenses are complex materials that must provide a range of physical properties in order to be effective, safe and comfortable to wear. These properties include: (1) high oxygen permeability in order to transmit O_2 to the cornea, (2) hydrophilic surface so that a continuous tear film coats the lens providing lubrication and (3) resistance to bacterial and protein adsorption. Understanding both the surface and bulk chemistry of lenses is critical to engineering optimal performance. The combination of surface sensitivity (0-5 nm sampling depth), standardless quantification and ability to detect not only elements but also functional groups make XPS (X-ray Photoelectron Spectroscopy) a powerful analytical tool for determining the near-surface chemistry of these materials.

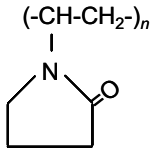
Survey scans below show a common hydrogel lens material (poly hydroxyethylmethacrylate (HEMA) without (Figure 1) and with (Figure 2) the incorporation of a hydrophilic polyvinylpyrrolidone (PVP) co-polymer. It is clear that XPS can detect PVP based on the nitrogen in the PVP-containing lens.

Lens Material	C	N	O
HEMA lens	69.1	0.0	30.9
HEMA + PVP lens	78.5	2.5	19.0
HEMA (theoretical)	66.7	0.0	33.3
PVP (theoretical)	75.0	12.5	12.5

polyhydroxyethyl methacrylate (HEMA)



polyvinylpyrrolidone (PVP)



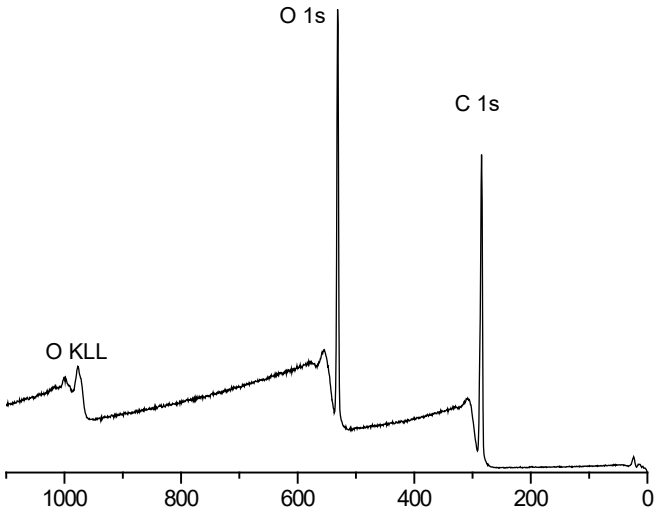


Figure 1: HEMA-based contact lens spectrum

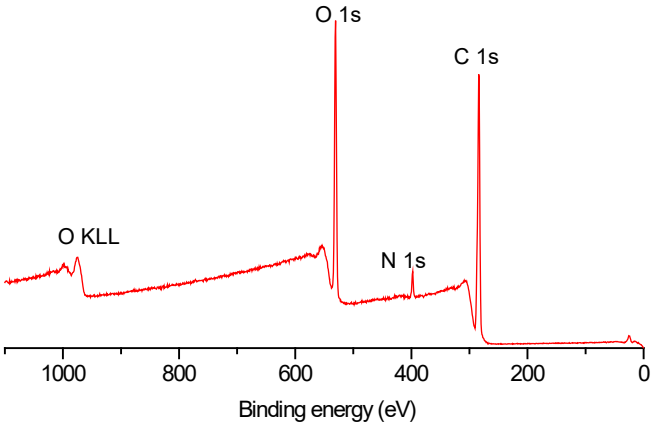


Figure 2: HEMA + PVP contact lens spectrum