Near-Ambient-Pressure XPS: a New Frontier in Surface Science

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The X-ray Photoelectron Spectroscopy (XPS) is a well-established and versatile technique commonly used in surface chemical analysis. Classical XPS analyses are performed under ultra-high vacuum (UHV) conditions and this strongly restricts the type of samples that can be investigated (*e.g.*, solid samples or liquids with a very low vapor pressure). Therefore, model systems rather than real samples in their natural environments can be investigated by using the standard XPS.

In Near-Ambient-Pressure X-ray Photoelectron Spectroscopy (NAP-XPS), the sample is surrounded by a gas atmosphere and no UHV conditions are required in the analysis area. Therefore, investigations of a large variety of different samples, including insulating samples, biological samples, gases, liquids and their interfaces are easily accessible.

These particular conditions during NAP-XPS analyses allow for some key applications, such as: (i) in-operando studies of electrochemical energy conversion and storage devices; (ii) in-situ investigations of medical and biological materials; (iii) processes at interfaces under reactive conditions for e.g. corrosion and catalytic studies; and (iv) surface studies in contact with gaseous or liquid environments.

Finally, in conventional XPS systems, where the analysis region needs to be kept under UHV, the surface charging effect often occurs. In NAP-XPS systems there are neutral gas atoms and molecules surrounding the sample, which can interact with impinging X-ray photons and thus become ionized, generating free positive charged ions and electrons. These free charges act as a charge cloud above the surface layer of the sample, allowing every escaping electron from the surface to be exchanged against an electron of the charge cloud, in a sort of intrinsic charge neutralization effect.

In this talk, the principles of the NAP-XPS will be discussed, highlighting the differences with conventional XPS systems and therefore the different range of applications. In addition, a selection of examples will be shown, elucidating the new frontier in surface science made possible by the Near-Ambient-Pressure X-ray Photoelectron Spectroscopy technique.

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