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Environmental Charge Compensation - Near Ambient Pressure XPS as a Tool for Surface Chemical Analysis of Iinsulators without Charging Effects

Abstract # 804

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Abstract:

Since many decades XPS (or ESCA) is the well-accepted standard method for non-destructive chemical analysis of solid surfaces. To fulfill this task existing ESCA tools combine reliable quantitative chemical analysis with comfortable sample handling concepts, integrated into fully automated compact designs.

Generically insulators will positively charge in XPS due to the irradiation with X-rays and the emission of photoelectrons. Without compensation this effect leads to strong continuous shifts and asymmetric line shapes of the emission lines in the spectra. To perform an exact characterization and quantification of strongly insulating materials different concepts of charge compensation or neutralization have been developed over the last decades. A short overview is given starting from low energy electrons offered from so-called "flood guns" or other sources, via compensation by a combination of electrons and ions to rare methods like illumination with visible light during the analysis and compensation by the produced electron-hole pairs. The opportunities and challenges of the different methods are compared.

The development of XPS method towards environmental or (near) ambient pressure working conditions has revolutionized this method regarding applications. In-situ and in-operando measurements in pressure of up to and above 25mbar are easily possible, even with laboratory based systems and using EnviroESCA even in a standard analytical tool.

During the last months, measurements on insulators have shown, that they can be measured with exception in surrounding pressures of a couple of mbar without any charging. This new technique of charge neutralization is neamed Environmental Charge Compensation (ECC).

This presentation summarizes results of measurements on insulating polymer samples, showing the resulting spectroscopic resolution for C1s and O1s emission lines. A comparison for PET and PTFE to other neutralization techniques is given. In addition measurements on bulk insulators from polymeric materials, ceramics, food samples, aqueous solutions, stones, soil and even zeolites are shown, that cannot easily be obtained in UHV based XPS systems.

Furthermore the effect is described in detail, including the influence of pressure and gas composition on the charge neutralization. An outlook is presented towards completely new resulting fields of application of XPS, when combined with ECC.