Characterization of materials by traceable X-ray spectrometry

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This contribution focuses on the development and applications of x-ray spectrometry methods for the analytical characterization of materials in different fields of applications ranging from semiconductor manufacturing to energy storage and conversion as well as cultural heritage related analysis. The development of and the assessment of advanced materials require the correlation of the materials' functionality with their underlying chemical and physical properties. The establishment of such a correlation strongly depends on the quantitative reliability, detection sensitivity and discrimination capability of the characterisation techniques employed. The lecture will explore how modern x-ray spectrometry including reference-material-free approaches can be optimized to meet these stringent requirements for various types of advanced materials. For cultural heritage applications such as provenience determination and restauration, physically based SI traceable methods of x-ray spectrometry can provide quantitative chemical information on art objects' composition even in the case of a lack of reference materials or appropriate calibration specimens. The quantification reliability of x-ray spectrometry methods can be improved by dedicated determinations of x-ray atomic fundamental parameters such as ionization cross sections and fluorescence yields using calibrated instrumentation and well-known tunable x-ray radiation of high spectral purity.

Intended audience: This contribution is aimed at young professionals and academics working in advanced materials manufacturing, environmental sciences and cultural heritage who are interested in the quantitative employment and optimization of analytical characterization techniques for advanced material development, manufacturing and quality control.

Learning outcomes: By the end of the lecture, participants will have an understanding of how x-ray analytical methods can be optimized to meet the demanding requirements of reliable characterizations of different materials. They will gain practical insights into the interplay between instrumental and experimental arrangements, quantification approaches including calibration and validation, as well as learn about strategies to improve analytical key parameters for specific applications. Attendees will also learn about recent advancements in hybrid x-ray spectrometric methodologies employed to characterize nanostructures, nano- and energy materials as well as interfaces, providing new pathways for the efficient correlation of the materials' functionality with the related chemical and physical properties and for the chemical analysis of complex art objects.

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