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**Book of Abstracts**

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## INTRODUCTION TO THE MICROANALYTICAL POSSIBILITIES OF SYNCHROTRON RADIATION

Laszlo Vincze\*

Ghent University, Department of Analytical Chemistry  
Krijgslaan 281 (S12), BE-9000 Ghent, Belgium

\* laszlo.vincze@ugent.be



### ABSTRACT

Synchrotron radiation based micro X-ray fluorescence (XRF) imaging is among the most powerful non-destructive microanalytical techniques which can provide two- and three-dimensional (2D/3D), potentially quantitative information on the elemental distributions within the probed sample volume with trace-level detection limits. Lateral resolution is ultimately limited by the X-ray beam size, which is typically in the 1 - 10  $\mu\text{m}$  range at a second generation synchrotron source while sub-micron resolution levels are becoming accessible (down to 30 - 100 nm) using 3rd generation sources coupled with advanced X-ray focusing optics.

This work illustrates the development of synchrotron radiation micro X-ray fluorescence imaging towards a fully three-dimensional, (quantitative) analytical method with lateral resolution levels down to the 0.2 - 10  $\mu\text{m}$  scale. Applications of (quantitative) 3D micro-XRF will be illustrated by the analysis of microscopic inclusions in natural diamonds, micrometeorites and environmental particles. The presented in-situ X-ray fluorescence microtomography and confocal X-ray microfluorescence imaging experiments were performed at the European Synchrotron Radiation Facility (ESRF) ID18F microfluorescence end-station and at the ESRF Microfocus beam line. Based on confocal imaging, fully three-dimensional distributions of trace elements could be obtained, representing a significant generalization of the regular 2D scanning technique for micro-XRF spectroscopy.

While visualizing elemental distributions qualitatively is relatively straightforward, quantitative 2D/3D micro-XRF spectroscopy of heterogeneous samples is hampered by the complex relationship of local elemental concentrations and fluorescence line intensities due to the variation of illuminated sample mass, matrix composition and sample topology as well as the lack of suitable standards for micro-XRF. In order to aid the quantitative evaluation and optimization of the above described scanning micro X-ray fluorescence experiments the use of a detailed Monte Carlo (MC) simulation model will also be illustrated which treats all aspects of the XRF quantification problem in their full complexity.