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Synchrotron techniques in environmental and agricultural science: the advantages of higher throughput and enhanced sensitivity

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A number of synchrotron-based techniques are increasingly being used to investigate nutrients and contaminant metals in a variety of environmental and biological samples. The advantages of these techniques are well known: minimal sample preparation (e.g. reduce risk of artefacts), high lateral and spatial resolution, ability to probe the speciation of elements in situ. However, until recently, synchrotron techniques have been considered generally 'slow' and not particularly sensitive in comparison with other methods providing very detailed information on a few samples at reasonably high concentrations. This has changed. The advent of fast and sensitive detector technologies has completely transformed the way we approach synchrotron experiments and the information we can obtain. For instance, traditionally, X-ray Fluorescence (XRF) elemental mapping has been used to gain an understanding of metal distribution while X-ray Absorption Spectroscopy (XAS) has been employed to investigate metal speciation. This latter approach has been performed at both the 'bulk' and microscale; these two approaches being complementary and providing different information. However, in the last few years, the development of a new generation of fast fluorescence detectors providing unprecedented rates of data acquisitions is blurring the divide between imaging and speciation techniques due to the developments of methods such as XANES-imaging (X-Ray Absorption Near Edge-imaging). Furthermore, fast detectors have allowed us to probe not just larger samples and more samples, they have also decreased the risk of beam damage, and, in-vivo time series experiments are now possible. At the same time, the development of ever more sensitive detectors and higher fluxes have enabled the analyses of trace element distribution and speciation at concentrations that are environmentally relevant. In this presentation we will discuss how new technologies have changed the information we can obtain from synchrotron experiments and how their design has changed over time. In particular, we will explore how the advances in a number of synchrotron techniques and their integration will provide new information not only in environmental science but also in agriculture. In the latter case, the ability to gain detailed information on large samples will provide a powerful avenue to add value to experiments conducted not only at laboratory scale but also at field scale.

Speakers Gender

Male

Travel Funding

No

Level of Expertise

Expert

Do yo wish to take part in the poster slam

No

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