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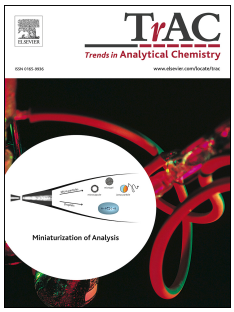

Advances in element speciation analysis of biomedical samples using synchrotron-based techniques

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Advances in element speciation analysis of biomedical samples using synchrotron-based techniques

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Highlights

- principle of direct element speciation with synchrotron X-ray absorption spectroscopy (XAS)
- experimental modalities for bulk- and micro-XAS speciation and their limitations
- review (2012-2017) of XAS in pharmacology, metals and nanoparticles toxicology, physiopathology
- future directions and developments of XAS speciation for biomedical research

Abstract

Synchrotron-radiation X-ray absorption spectroscopy (XAS) is a direct method for speciation analysis with atomic resolution, providing information about the local chemical environment of the probed element. This article gives an overview of the basic principles of XAS and its application to element speciation in biomedical research. The basic principle and experimental modalities of XAS are introduced, followed by a discussion of both its limitations, such as beam damage or detection limits, and practical advices to improve experiments. An updated review of biomedical studies involving XAS published over the last 5 years is then provided, paying special attention to metal-based drug biotransformation, metal and nanoparticle toxicology, and element speciation in cancer, neurological, and general pathophysiology. Finally, trends and future developments such as hyphenated methods, *in situ* correlative imaging and speciation, *in vivo* X-ray Absorption Near Edge Spectroscopy (XANES), full-field XANES, and X-ray Free Electron Laser (XFEL) XAS are presented.

Keywords

synchrotron; XAS; speciation; EXAFS; XANES; XFEL; metals ; nanoparticles; cancer, neuropathology.