

## A TOP-DOWN APPROACH USING X-RAY IMAGING TECHNIQUES: INSTRUMENTAL DEVELOPMENTS AND APPLICATIONS IN LIFE SCIENCE

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Synchrotron radiation X-ray fluorescence micro- and nanobeam techniques at second- and third generation SR sources offer the potential of non-destructive multi-element analysis down to trace concentration levels with unrivalled spatial resolution among X-ray based analytical techniques. At these sources, relative detection limits at the sub-ppm (fg/ng) level can be achieved. With respect to absolute detection limits (DL), sub-micron sized X-ray beams can offer DLs below 1 ag for the most efficiently excited transition elements, with a potential lateral resolution level better than 100 nm.

These characteristics of micro/nanobeam SR-XRF allow spatially resolved multi-element determination of major, minor and trace constituents in microscopic sub areas and volumes within biological specimens in an essentially non-destructive/non-invasive manner. However, the complexity of performing such an experiment is often quite considerable, involving dedicated sample preparation, transportation towards and experimenting at the synchrotron facility, installing an appropriate experimental set-up and performing a thorough data analysis on large amounts of spectral data.

The ecotoxicological research on *Daphnia magna*, a frequently used model organism for investigating the mechanisms of toxicity of metals, has often been difficult because many analytical techniques are not able to investigate trace metal distributions in a spatially resolved manner at a (sub)microscopic resolution. As illustrated by this presentation, SR-XRF microanalysis allows to fill this gap and moreover, due to the variety in sizes of X-ray beams available, this research can be performed from the organism level towards the tissue and cellular level, representing a top-down approach.

### Reference:

Three-dimensional elemental imaging by means of synchrotron radiation micro-XRF: developments and applications in environmental chemistry, Anal. Bioanal. Chem. (2008) 390:267-271