

X-RAY IMAGING ON BIOLOGICAL MODEL ORGANISMS USING MICRO AND NANO X-RAY FLUORESCENCE

B. De Samber^A, K. De Schamphelaere^B, B. Masschaele^C, S. Vanblaere^B, S. Bohic^D, G. Martinez-Criado^D, R. Tuculou^D, P. Cloetens^D, G. Falkenberg^E, F. Vanhaecke^A, L. Van Hoorebeke^C, C. Janssen^B and L. Vincze^A

Department of Analytical Chemistry, Ghent University^A

Laboratory of Environmental Toxicology and Aquatic Ecology, Ghent University^B

Department of Subatomic and Radiation Physics, Ghent University^C

European Synchrotron Radiation Facility^D

Hamburger Synchrotronstrahlungslabor at DESY^E

Micro X-ray fluorescence (μ -XRF) is a rapidly evolving analytical technique which allows visualizing the trace level metal distributions within a specimen in an essentially non-destructive manner. At second- and third generation synchrotron radiation (SR) sources, detection limits at the sub-ppm level can be obtained with a potential lateral resolution level better than 100 nm.

The ecotoxicological research on *Daphnia magna*, a frequently used model organism for investigating the mechanisms of toxicity of metals, is not trivial because many analytical techniques are not able to investigate trace metal distributions in a spatially resolved manner at a (sub)microscopic resolution. A laboratory μ -XRF spectrometer (EDAX Eagle III) allowed us to precharacterize the major/minor element distributions within *Daphnia magna* with a moderate spatial resolution of approximately 20 μ m. However, synchrotron radiation μ -XRF experiments were necessary (Beamline L, HASYLAB) with substantially increased elemental sensitivities to visualize the tissue specific Zn accumulation within *Daphnia magna*. This work demonstrates the use of combined X-ray techniques, including two-dimensional (2D) μ -XRF, XRF micro-CT, confocal μ -XRF and absorption microtomography under conventional and cryogenic sample environments.

With the aim of shifting from the microscopic tissue scales towards a subcellular field of view, the tissues of interest were isolated and analyzed at the ID22NI nanoprobe (ESRF). The combination of high flux ($\sim 10^{12}$ photons/s) and high resolution (100 nm) proved to be of vital importance to visualize the inter- and intracellular distribution of trace metals within *Daphnia magna*. These nanochemical imaging results will be likely to provide new insights in the cellular detoxification process within these model organisms.

References

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Contact:

B. De Samber
X-ray Microspectroscopy and Imaging group (XMI)
Krijgslaan 281 (S12)
9000 Gent
tel.: +32(0)92644855
fax.: +32(0)92644960
Bjorn.DeSamber@UGent.be

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