Analytica Chimica Acta 835 (2014) 1–18

Contents lists available at ScienceDirect

Analytica Chimica Acta

journal homepage: www.elsevier.com/locate/aca

Review

Bioimaging mass spectrometry of trace elements – recent advance and applications of LA-ICP-MS: A review

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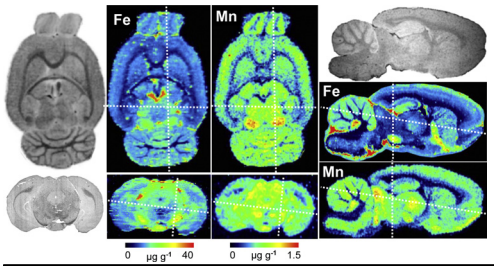
HIGHLIGHTS

- Bioimaging LA-ICP-MS is established for trace metals within biomedical specimens.
- Trace metal imaging allows to study brain function and neurodegenerative diseases.
- Laser microdissection ICP-MS was applied to mouse brain hippocampus and wheat root.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 10 June 2013
Received in revised form 18 April 2014
Accepted 19 April 2014
Available online 26 April 2014

In memoriam of Hans-Joachim Dietze (10.11.1935–27.02.2014)

Keywords:
Elemental bio-imaging
Laser ablation inductively coupled plasma mass spectrometry
LA-ICP-MS
Trace metal imaging

ABSTRACT

Bioimaging using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) offers the capability to quantify trace elements and isotopes within tissue sections with a spatial resolution ranging about 10–100 μm. Distribution analysis adds to clarifying basic questions of biomedical research and enables bioaccumulation and bioavailability studies for ecological and toxicological risk assessment in humans, animals and plants. Major application fields of mass spectrometry imaging (MSI) and metallomics have been in brain and cancer research, animal model validation, drug development and plant science. Here we give an overview of latest achievements in methods and applications. Recent improvements in ablation systems, operation and cell design enabled progressively better spatial resolutions down to 1 μm. Meanwhile, a body of research has accumulated covering basic principles of the element architecture in animals and plants that could consistently be reproduced by several laboratories such as the distribution of Fe, Cu, Zn in rodent brain. Several studies investigated the distribution and delivery of metallo-drugs in animals. Hyper-accumulating plants and pollution indicator organisms have been the key topics in environmental science. Increasingly, larger series of samples are analyzed, may it be in the frame of comparisons between intervention and control groups, of time kinetics or of three-dimensional atlas approaches.

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http://dx.doi.org/10.1016/j.aca.2014.04.048
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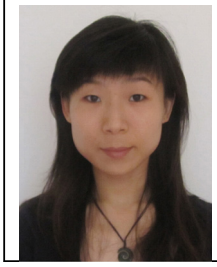

Bei Wu received her PhD in Environmental Engineering at Zhejiang University, China, in 2009. After working as an Alexander von Humboldt postdoctoral fellow, she was a scientific coworker at the BrainMet laboratory at Forschungszentrum Jülich (FZJ), Germany, working on the development of LA-ICP-MS imaging of metals/metalloids with high spatial resolution down to the low- and sub-μm range. Her forthcoming research activities will investigate elemental cycling in soil system using advanced mass spectrometric techniques in the Institute of Bio- and Geosciences, FZJ.

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