Applications of nuclear microprobe imaging in neuroscience

Richard ORTEGA [1]

[1]*CENBG*

Essential trace metals such as Fe, Cu, or Zn are involved in biochemical processes required for the functioning of the nervous system, and as a corollary such metal based functions can be hampered by a dysregulation of metal homeostasis, or by the competition with exogenous neurotoxic metals. For instance most neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease, amyotrophic lateral sclerosis, etc, are associated with an alteration of trace metal homeostasis.

Therefore there is an increasing need for trace element imaging in neurobiology and neuropathology research. Such imaging of trace metals distribution in the nervous system is achievable by a variety of analytical tools, including the nuclear microprobe. This review will focus on the recent applications of nuclear microprobe in neuroscience research, with some emphasis on the complementary use of element imaging at different length scales: (i) the organ or tissue level, as illustrated by micro-PIXE imaging of element distributions in brains, (ii) the cellular level, used for example to image element localization in sub-cellular organelles of neurons, and

(iii) the protein level, for trace metal quantification in metalloproteins, after protein separation using electrophoresis. The ability to derive the spatial distribution of elements on this diversity of length scales is a key to understanding the mechanisms involved in the etiology of neurodegenerative diseases.

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