

Nanomagnets on the Mind

N. D. Telling¹, J. F. Collingwood², G. van der Laan³, J. J. Gallagher⁴, A. P. Hitchcock⁵, and J. Dobson¹

¹*Institute for Science and Technology in Medicine, Keele University, UK*

²*School of Engineering, Warwick University, UK*

³*Magnetic Spectroscopy Group, Diamond Light Source, UK*

⁴*Institute of Neuroscience, Trinity College Dublin, Ireland*

⁵*Department of Chemistry and Chemical Biological, McMaster University, Canada*

Recent studies on Alzheimer's disease (AD) have highlighted a possible connection between neurodegeneration and increased levels of iron and other trace metals at certain sites in the brain [1]. It is well established that iron can be precipitated biochemically in the form of nanoscale magnetite (Fe₃O₄) by organisms ranging from simple microbes, such as the Fe(III) reducing bacterium *Geobacter sulfurreducens* [2], through to fish and other animals [3]. However it is probably less well known that human magnetite biomineralization has been observed, following studies of post-mortem brain tissue samples taken from AD sufferers [4-6]. The occurrence of nanoscale forms of this redox active iron mineral, co-localised with a peptide known as beta-amyloid, could be linked with the formation of free radicals that attack and damage neurons.

Brain tissue obtained from mice that were genetically modified to contain the human gene associated with AD has been shown to provide a highly relevant model of AD in humans. We present here a study utilising scanning transmission x-ray microscopy (STXM) to identify and map the distribution of iron biominerals and other biological iron compounds in the brain of AD transgenic mice. In particular we will discuss the distribution of such compounds in the vicinity of aggregates of the beta-amyloid peptide. STXM is unique in that it not only enables us to map the distribution of both the iron minerals and associated biological material on nanometre length scales, but we can also (using spectromicroscopy) unambiguously separate magnetite formation from other iron minerals that possess very similar crystal structures, such as maghemite. Using this approach we aim to understand the formation of iron minerals in the brain and their role in the pathology of Alzheimer's disease.

References

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Email corresponding author: n.d.telling@istm.keele.ac.uk Preference: ~~Oral~~ **Poster**