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SIMS Protein imaging with nanoparticle tagged antibody for simultaneous omic imaging

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One of the major problems of biological ToF-SIMS imaging is the lack of protein and peptide imaging. Most of biological story telling is mianly based on proteins. The biological implication of lipid ToF-SIMS imaging would be much higher if protein imaging is provided together. Utilizing high secondary ion yields of metals, proteins can be ToF-SIMS imaged with nanoparticle tagged proteins. Nanoparticles such as Fe3O4, SiO2, PbS were used for imaing NeuN, MCH, Orexin A, α synucline, TH(Tryosine Hydroxylase) in mouse tissues with a spatial resolution of ~2 μ m using a TOF-SIMS.

Lipids and neurotransmitters images obtained simultaneously with protein images were overlayed for more deeper understanding of neurobiology, which is not allowed by any other bioimaging technqiues. The protein images from TOF-SIMS were compared with confocal fluorescence microscopy and NanoSIMS images.

A new sample preparation method for imaging single cell membranes in a tissue using the vibrotome technique to prepare a tissue slice without any fixation and freeze drying will be also presented briefly for Hippocampus and Hypothalamus tissues.

Keywords: SIMS, MS imaging, Protein

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X-ray absorption spectroscopic study of $MgFe_2O_4$ nanoparticles

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Nanoparticles of magnesium ferrite are used as a heterogeneous catalyst, humidity sensor, oxygen sensor and cure of local hyperthermia. These applications usually utilize the magnetic behavior of these nanoparticles. Moreover, magnetic properties of nanoferrites exhibit rather complex behavior compared to bulk ferrite. The magnetic properties of ferrites are complicated by spins at vortices, surface spins. Reports till date indicate strong dependency on the structural parameters, oxidation state of metal ions and their presence in octahedral and tetrahedral environment. Thus we have carried out investigation on magnesium ferrite nanoparticles in order to study coordination, oxidation state and structural distortion. For present work, magnesium ferrite nanoparticles were synthesized using nitrates of metal ions and citric acid. Fe L-edge spectra measured for these nanoparticles shows attributes of Fe^{3+} in high spin state. Moreover O K-edge spectra for these nanoparticles exhibit spectral features that arises due to unoccupied states of O 2p character hybridized with metal ions. Mg K-edge spectra shows spectral features at 1304, 1307, 1311 and 1324 eV for nanoparticles obtained after annealing at 400, 500, 600, 800, 1000, and 1200 ℃. Apart from this, spectra for precursor and nanoparticles obtained at 300 ℃ exhibit a broad peak centered around 1305 eV. A shoulde rlike structure is present at 1301 eV in spectra for precursor. This feature does not appear after annealing. After annealing a small kink appear at ~1297 eV in Mg K-edge spectra for all nanoparticles. This indicates changes in local electronic structure during annealing of precursor. Observed behavior of change in local electronic structure will be discussed on the basis of existing theories. $^{3+}$

Keywords: Nanoparticles, NEXAFS, Magnesium ferrite