Applications of NanoSIMS in Biological Materials

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The NanoSIMS enables high spatial resolution elemental and isotopic imaging (down to 50 nm), with high sensitivity, making it ideally suited for subcellular localisation of elements and isotopic tracers in biological materials.

In this presentation, I will show how NanoSIMS can be applied to a range of biological samples. Examples will illustrate how elements of interest can be correlated to other signals to understand elemental uptake or storage mechanisms and how stable isotopes can be used in pulse-chase experiments which can provide temporal information about uptake and metabolism.

The analysis of biological samples with the NanoSIMS, which operates under ultra-high vacuum, is complicated by the need to preserve not only the in-vivo structure of the cellular components but also the elemental distribution. This presentation will outline the two main approaches for sample preparation, chemical or cryo fixation, and how the choice depends on the biological question or the size of the sample. In all cases the ideal sample preparation methodology workflow is fixation, dehydration, resin embedding and microtomy to create a sample that is flat and high-vacuum compatible. Sample preparation methods will be discussed in the context of the examples presented.

In this presentation I will show case studies of how we have used the NanoSIMS to analyse a range of biological materials ranging from trace element uptake in plants and algae, use of isotopic labelling to investigate the feeding mechanism of the whipworm parasite, the analysis of bacteria and nanoparticle distributions in plants and algae. Throughout my presentation I will show how we have used complementary and correlative imaging and how it fits into the broader analytical workflow to gain a deeper understanding of the samples than could be obtained from one technique alone.