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Chemical imaging of biological materials by NanoSIMS using isotopic and elemental labels

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The NanoSIMS 50 combines unprecedented spatial resolution (as good as 50 nm) with ultra-high sensitivity (minimum detection limit of ~200 atoms). The NanoSIMS 50 incorporates an array of detectors, enabling simultaneous collection of 5 species originating from the same sputtered volume of a sample. The primary ion beam (Cs^+ or O^-) can be scanned across the sample to produce quantitative secondary ion images. This capability for multiple isotope imaging with high spatial resolution provides a novel new approach to the study of biological materials. Studies can be made of sub-regions of tissues, mammalian cells, and bacteria. Major, minor and trace element distributions can be mapped on a submicron scale, growth and metabolism can be tracked using stable isotope labels, and biogenic origin can be determined based on composition. We have applied this technique extensively to mammalian and prokaryotic cells and bacterial spores. The NanoSIMS technology enables the researcher to interrogate the fate of molecules of interest within cells and organs through elemental and isotopic labeling. Biological applications at LLNL will be discussed.

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