SIMS analysis of biological and biotechnology surfaces using cluster ion beams

John Vickerman,
School of Chemical Engineering and Analytical Science, University of Manchester, UK
John.Vickerman@manchester.ac.uk

The requirements of molecular analysis in bio-systems are very demanding. In principle static SIMS as a surface mass spectrometry has the capability to deliver the high level of chemical specificity required. However, in general the emission and ionisation process using atomic primary ion beams does not deliver the secondary ion yields over the mass range necessary to provide the analytical information required to provide any sort of detail when analysing complex biological systems. The problem is greatly exacerbated when analysis with good spatial resolution is required. When analysis is restricted by the static limit, there are just too few molecules in the pixel area to permit analysis to be carried out.

Basically SIMS analysis of complex organic and biological materials has been limited by secondary ion yield, by the yield of intact molecules above m/z ~ 500 and by being limited to the static limit which in turn prevented molecular depth profiling. Building on work that dates from the 1980s – 1990s recent exploration of the use of polyatomic primary ion beams has shown that quite dramatic increases in secondary ion yield can result from organic analytes. Furthermore there is increasing evidence that some polyatomic beams generate much less bombardment induced chemical damage than atomic beams. This observation implies that it may be possible to abandon the static limit for the analysis of some materials. This in itself could greatly increase the potential analytical yield. It also suggests the possibility of molecular depth profiling.

It is clear that polyatomic primary ions have potentially opened up the analysis of biological materials to SIMS analysis and imaging. The problem that is beginning to emerge however is that with higher ion yields from complex materials, the spectra and images will require sophisticated computational methods to interpret. The paper will review where the field stands at the moment.