

Attempts for molecular depth profiling directly on a rat brain tissue section using fullerene and bismuth cluster ion beams

Delphine Debois, Alain Brunelle, Olivier Laprevote

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The capabilities of time of flight secondary ion mass spectrometry (TOF-SIMS) have been recently greatly improved with the arrival in this field of polyatomic ion sources. This technique is now able to map at the micron scale intact organic molecules in a range of a thousand Daltons or more, at the surface of tissue samples. Nevertheless, this remains a surface analysis technique, and three-dimensional information on the molecular composition of the sample could not be obtained due to the damage undergone by the organic molecules during their irradiation. The situation changed slightly with the low damage and low penetration depth of the C₆₀ fullerene ion beams. Recent promising studies have shown the possibility of organic molecular depth profiling using this kind of beams onto model samples. This possibility has been tried out directly onto a rat brain tissue section, which is the most commonly used biological tissue model in TOF-SIMS imaging method developments. The tissue surface has been sputtered with a 10 keV energy fullerene ion beam, and surface analyses were done with a 25 keV Bi³⁺ ion beam at regular time intervals. The total depth which was analysed was more than two microns, with total primary ion doses of more than 10¹⁶ ions cm⁻². Although not in contradiction with results previously published but with much lower doses, it is found that the molecular damage remains too large, thus making molecular imaging very difficult. In addition, most of the lipids, which are usually the main observable molecules in TOF-SIMS, are concentrated close to the sample surface in the first hundreds of nanometers.

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