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Introduction to Secondary Ion Mass Spectrometry (SIMS)

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Abstract

The impact of ions in the keV energy range on a solid causes the mixing of atoms close to the surface and ejection of material from the surface (sputtering). Sputtered particles can be single atoms, clusters of atoms, or molecules and they can be neutral or ionized. By mass analysis of the ejected secondary ions information on the composition of the material as a function of depth can be gained (Secondary Ion Mass Spectrometry, SIMS). The positive as well as the negative secondary ion yields are strongly depending of the material composition and the type and energy of the primary ion. This complicates the exact quantification of concentrations. Nevertheless, SIMS is a very sensitive analysis technique which can be easily used to map atomic and molecular species on a surface and even measure three-dimensional distributions.

The use of cluster ions in the primary beam has a dramatic effect on sputtering characteristics, in particular on the emission of molecular secondary ions. This can be exploited for chemical speciation at the sample surface.

KEYWORDS: nuclear energy loss, sputtering, secondary ion yields, charge state, mass spectrometry, composition mapping, cluster ion beams, molecular ions.

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