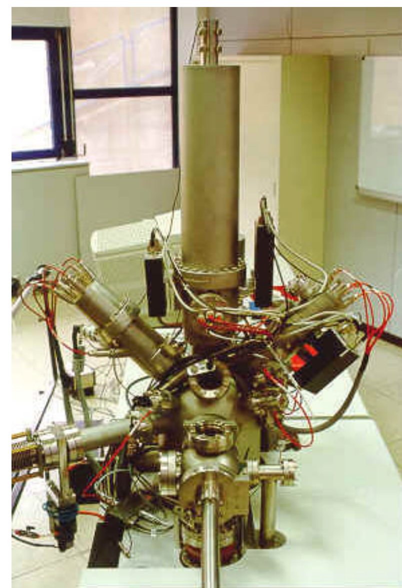
ToF-SIMS

Time of Flight (Static) Secondary Ion Mass Spectrometry

Technique

In a TOF-SIMS instrument, emission of secondary atomic or molecular ions is caused by a pulsed ion beam. Secondary ions are collected and accelerated by an electrostatic potential, thereby reaching a velocity which is a function of their mass. At this velocity, they travel through a field-free region before reaching the detector. The time *t* needed is proportional to the ion mass *m* and to the length of the field-free region *l*.



$$\frac{m}{z} \propto 2eE\left(\frac{t}{l}\right)^2$$

Ions are therefore sequentially detected, so that all the ions of a given polarity etched by a single pulse can be measured. In a spectrum or image acquisition, the sample is typically bombarded by 10^9-10^{12} primary ions/cm^2. Therefore, a surface characterization is completed without removing the first monolayer. The high instrument transmission, together with the high collection and detection efficiency of the secondary ions, give to the technique a sensitivity which is higher with respect to quadrupole or magnetic sector instruments.

Most important features

The most important feature is its ability to provide 2-dimensional spatial distributions of both elements and chemical compounds (through the analysis of molecular ions) on virtually each kind of solid materials, i.e. with no limitations with respect to insulating, organic or easily damaged samples. Wide applications of the technique are therefore found in the analysis of polymers (the packaging industry is perhaps the leading example in this respect), organic materials, biological samples, that is all those areas which are not or only hardly accessible to the traditional mass spectrometric techniques.

Applications

In microelectronics it can be used to detect organic or inorganic surface contamination on blank wafer or device. Depth profiles are also available using a complementary sputter ion gun.

Instrument		**Cameca TOF-IV** (operating since 1996)
Ion sources	**- analysis**	Ga ion gun (typically 25keV);
	- sputtering	Cs, O_2 ion gun (1÷10keV)
Analyzer		Reflectron
Sample surface imaging		via optical microscope
Mass resolution M/ΔM		~8000 (M = 28.09)
Mass range		no limits (tipically 10 000)
Spatial resolution		0.1 µm (minimum ion beam diameter) Multiple point analysis, line scans and maps can be acquired
In-depth information		the Cs gun is used for the sputtering
Charge compensation		electron gun