

The Outer Surface, Ultra-thin Layers and Contacts Studied by LEIS

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In modern technology new (sub-) nanometer materials and preparation techniques are being developed. Advancement relies heavily on the availability of analytic techniques that can validate and support the preparation. One of the new analytic techniques that is being used is Low-Energy Ion Scattering (LEIS or ISS). Its unique surface sensitivity makes it possible to selectively determine the atomic composition of the outer atoms of the surface, while LEIS can nowadays also be used for non-destructive in-depth analysis down to about 6 - 10 nm below the surface.

In Eindhoven we have developed a new type of analyzer and detector for LEIS. The use of a 2-dimensional array of detectors has increased its sensitivity by a factor of 3000 compared to conventional LEIS set-ups. The technique is just as well suited for the quantitative analysis of amorphous, insulating and extremely rough surfaces as for flat conducting single crystals. This has opened many new possibilities in microelectronics, coatings, adhesion control, catalysis, etc.

After an introduction of the technique, the focus will be on applications where valuable information has been obtained that is impossible (or very difficult) to obtain with other analytical techniques. The new possibilities will be illustrated with a selection of examples from:

- Atomic layer deposition (ALD) of ultra-thin layers for diffusion barriers and high-k dielectrics
- Pinholes in coatings
- Metal - polymer interfaces
- Self-assembled monolayers
- Intra- and inter-molecular segregation

The results and possibilities of this new type of LEIS will be compared and contrasted to those by more conventional surface analytic techniques such as XPS, ToF-SIMS, Auger as well as higher energy ion scattering techniques (RBS/MEIS).
