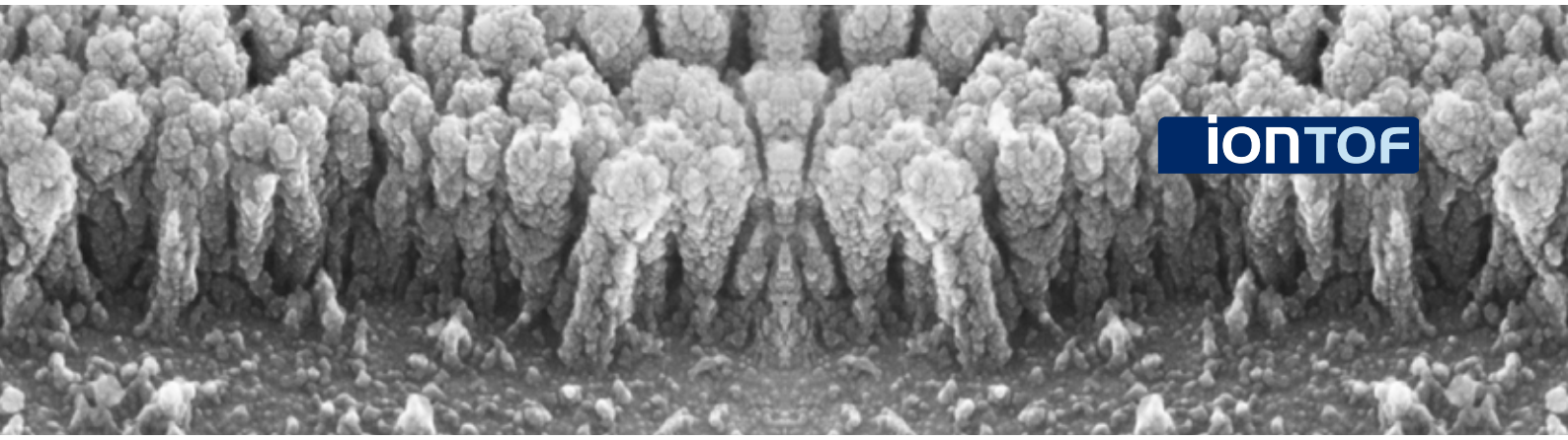

Nanoparticles

Elemental characterisation of the outermost atomic layer

Many applications rely on the chemical interaction of nanoparticles with their environment, which is determined by the surface chemistry of the particles. While the physical properties and average composition are routinely measured, very few techniques can analyze the surface composition. Low Energy Ion Scattering (LEIS) is ideally suited for this task, thanks to its ultimate surface sensitivity.

In LEIS, the energy of an ion scattered from the surface is specific for the surface atom which was part of the scattering process. At the same time, neutralisation effects lead to a strong suppression of signal from deeper layers, resulting in distinct surface peaks. The peak positions identify the elements of the outermost atomic layer, while the intensity is directly proportional to the surface coverage. This allows a quantitative elemental characterisation of the outermost atomic layer – even on rough and insulating surfaces.

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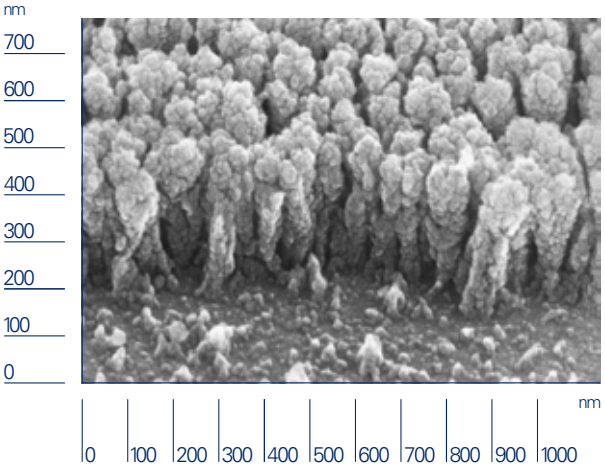
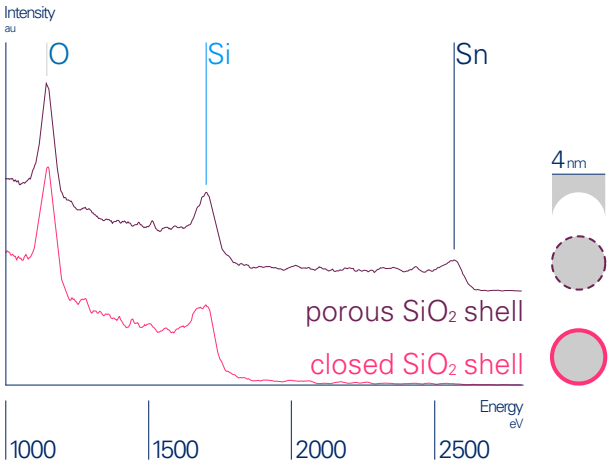
Analysis of core-shell nanoparticles

SnO_2 nanoparticles with a diameter of less than 10 nm are used for gas sensing applications. To prevent agglomeration and growth, a thin shell of SiO_2 is applied in a downstream process during particle production. In order to allow gas permeation as well as electrical contact, a porous shell is required.

By LEIS the porosity of the shell can be measured directly: the surface coverage of Si and Sn are determined and directly yield the surface coverage of the shell and the pores. This allows tuning the synthesis conditions and optimizing the performance and stability of the sensor.



SEM images of a SnO_2 core/SiO_2 shell nanoparticle thin film on a silicon substrate



LEIS spectra of core-shell nanoparticle thin films with different shell thicknesses after atomic oxygen cleaning

Samples and SEM images are kindly provided by M. Bruns, Karlsruhe Institute of Technology. For further details see M. Fuchs et al., Surf. Interface Anal. 42, 6-7, 1131-1134 (2010)