

17.8 Calibration, standardization

For distribution analysis of solid specimens, e.g. semiconductors only limited efforts concerning the determination of systematic errors and consequently accuracy have been undertaken. One of the reasons for this is the small number of methods available, their often narrow range of applicability and rather large systematic errors. One of the major tasks at the present state of experience is therefore the development of a suitable strategy for the combination of various techniques to achieve a specific analytical goal (e.g. the distribution analysis of B in silicon) to achieve a most accurate characterization of a material.

The general requirements for distribution analysis are:

- large dynamic range of analysis and high detection power:
 $10^{14} - 5 \times 10^{24} \text{ cm}^{-3}$ (1 ng g⁻¹ - %)
- high spatial (depth) resolution: $\Delta z = 1 - 10 \text{ nm}$
- high accuracy of distribution information (concentration vs. depth)

In order to be able to combine methods of elemental analysis with electrical measurements for reference purposes the trace elements have to be in an electrically active state which demands annealing if doping has been performed by ion implantation. For non-annealed implant samples, the calculation of the distribution of the dopant by mathematical-physical models is another feasible way checking experimental results. The distribution can be described in terms of statistical distribution functions such as the Gaussian (2 moments) or the Pearson IV (4 moments) or by Monte Carlo simulation. Since, however, the accuracy of calculated distributions has to be determined experimentally these methods cannot be seen as reference methods, but rather as supplementary techniques to assess the accuracy of a measurement.