Improved Method for Probing Resistivity and Doping Concentration of Semiconductors at the Nanoscale Using Scanning Microwave Microscopy (SMM)

Matthias A. Fenner [A], Enrico Brinciotti [B], Georg Gramse [C], Ferry Kienberger [B]

[A] *Keysight Technologies Deutschland GmbH, Lyoner Strasse 20, 60528 Frankfurt, Germany*
[B] *Keysight Technologies Austria GmbH, Keysight Labs, Gruberstrasse 40, 4020 Linz, Austria*
[C] *Johannes Kepler University, Biophysics Institute, Gruberstrasse 40, 4020 Linz, Austria*

We describe an improved method using a combination of AFM and local microwave measurement (SMM) for a quantitative determination of resistivity and doping concentration of semiconductor materials on a nanometer scale. The microwave reflection signal (S11) is converted into calibrated resistance and capacitance data via a three error parameters workflow which does not require a calibration step on a known dopant standard sample [1]. By means of an analytical model for the junction of AFM tip and semiconductor the resistance can be converted into resistivity and dopant density data. The method was applied on a silicon sample with p and n doped implant regions and yields a good quantitative agreement with the data-sheet values.

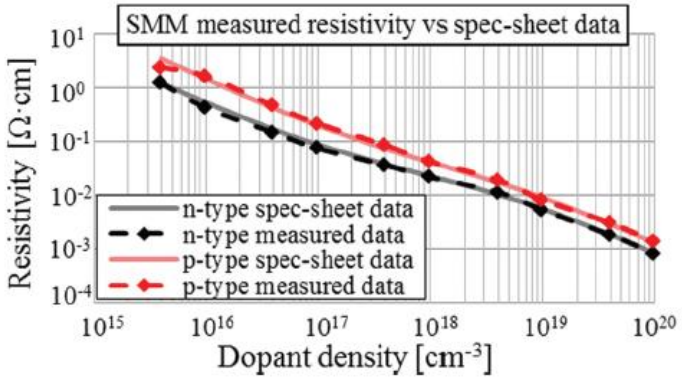

Figure 1 : Comparison of of measured resistivities to data sheet values for doped silicon.

Références

[1] Calibrated complex impedance and permittivity measurements with scanning microwave microscopy, Gramse et al. ,2014, Nanotechnology 25 (2014) 145703