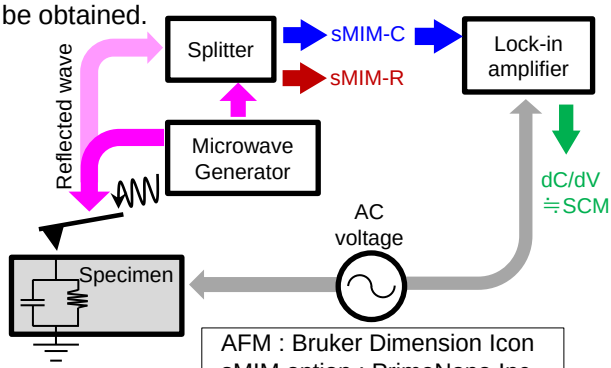
ITES

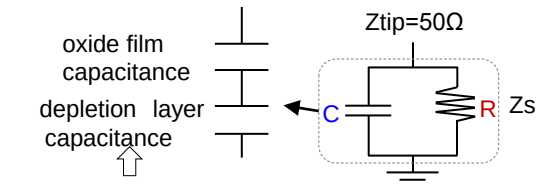
Carrier Distribution Analysis in Semiconductors by sMIM

Principles of sMIM (Scanning Microwave Impedance Microscopy) Analysis

The sMIM system measures the reflected waves from a specimen scanned by microwave irradiation from the tip of a metal probe attached to an SPM, to obtain an sMIM-C image that has a linear correlation with the concentration of diffusion layers. The C(capacitance) component of Zs(impedance) obtained from the reflectance is composed of the oxide film capacitance and depletion layer capacitance, and the change in concentration is detected as a change in C, utilizing the fact that the depletion layer width changes depending on the carrier concentration. Furthermore, by applying AC voltage, dC/dV image (≒SCM) can be obtained.



AFM : Bruker Dimension Icon
sMIM option : PrimeNano Inc.



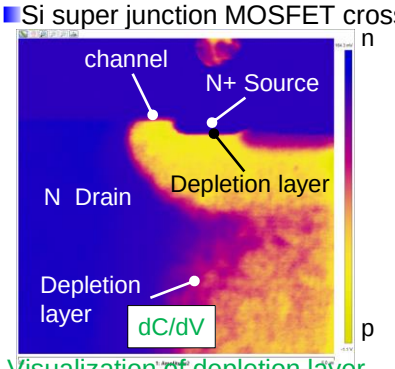
altered depending on the carrier concentration

Reflectance =(Zs- Ztip)/ (Zs+ Ztip)

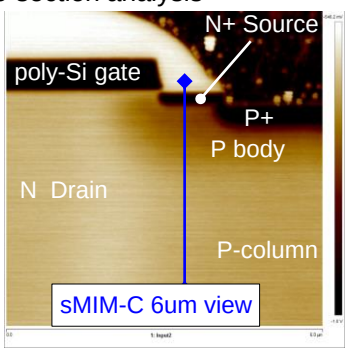
sMIM-C sensitivity：1E14～1E21
Spatial resolution：20nm～200nm
(The lower the concentration, the coarser)

Analysis Examples

Si super junction MOSFET cross-section analysis

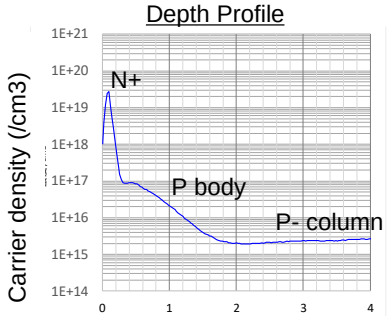


Visualization of depletion layer, p/n distinction



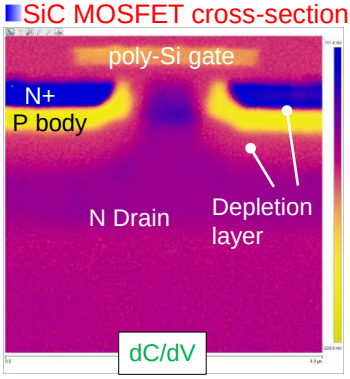
Linear relation to carrier density

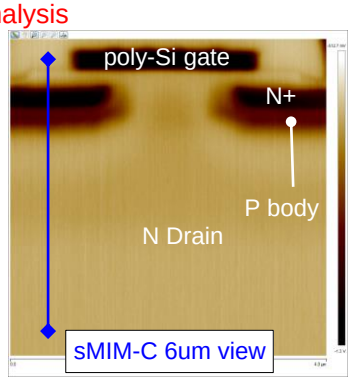
Depth Profile



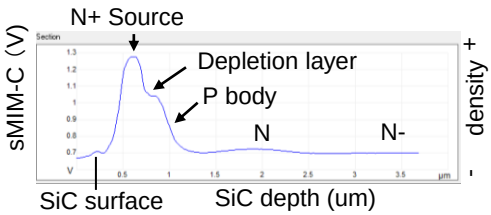
Analysis of standard specimen(SSRM-SMPL-P/N) enables quantification of carrier concentration

SiC MOSFET cross-section analysis





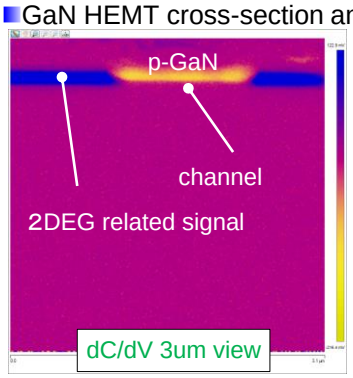
sMIM-C signal profile

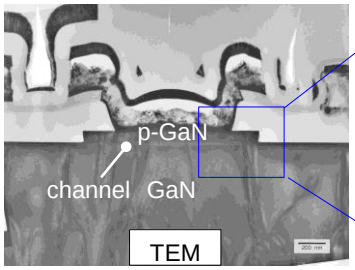


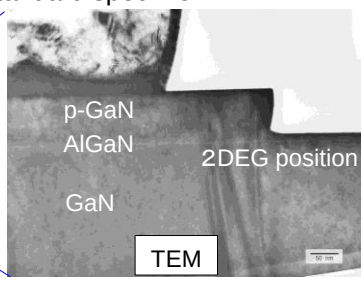
・Quantification of carrier concentration is possible by SiC standard specimen.

・Relative comparison is possible even by Si standard specimen.

GaN HEMT cross-section analysis







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