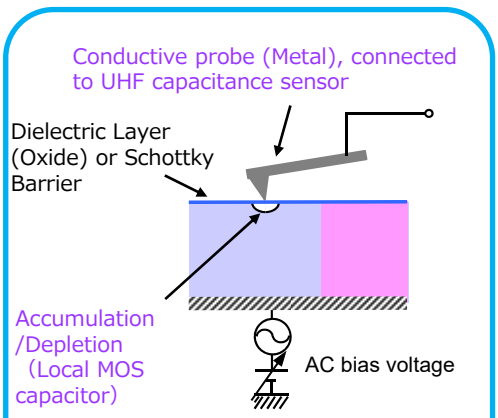
Analysis of carrier distribution and p-n junction of Power semiconductor —SCM, DPC-STEM—

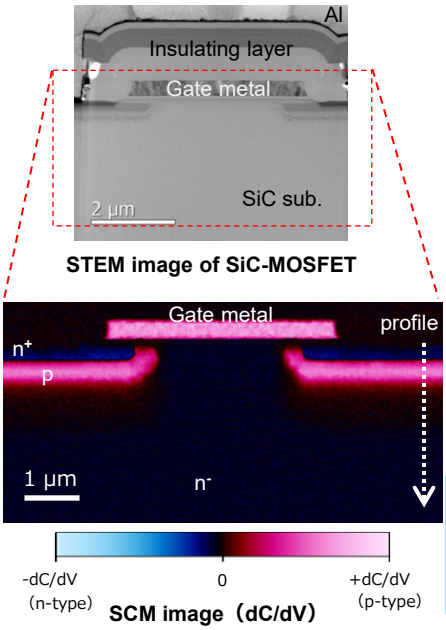
By scanning capacitance microscopy (SCM) and differential phase contrast imaging (DPC) in scanning transmission electron microscopy (STEM), Analysis examples of carrier distribution and p-n junction of SiC MOSFET device are shown.

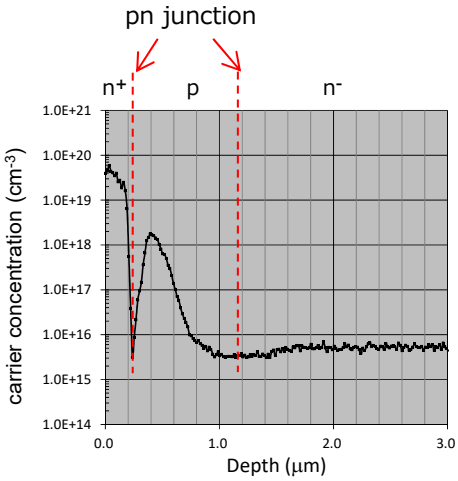
Evaluation of carrier distribution using SCM



Conceptual schematic of SCM

The capacitance of the depletion beneath the probe can be detected as a d*C*/d*V* signal. The signal depends on carrier type and concentration.



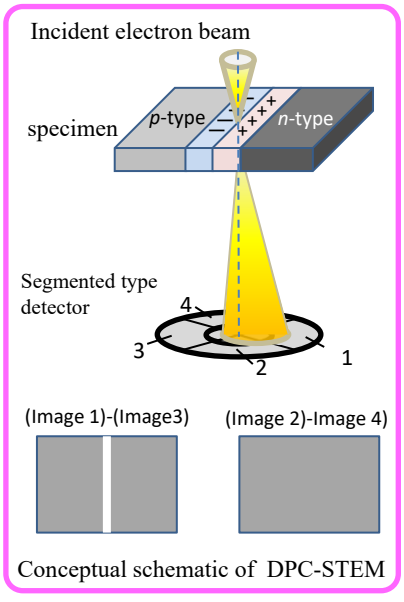


Depth profiles of carrier concentration

・n+ layer : 2×10^{19}
・p layer : 1×10^{18}

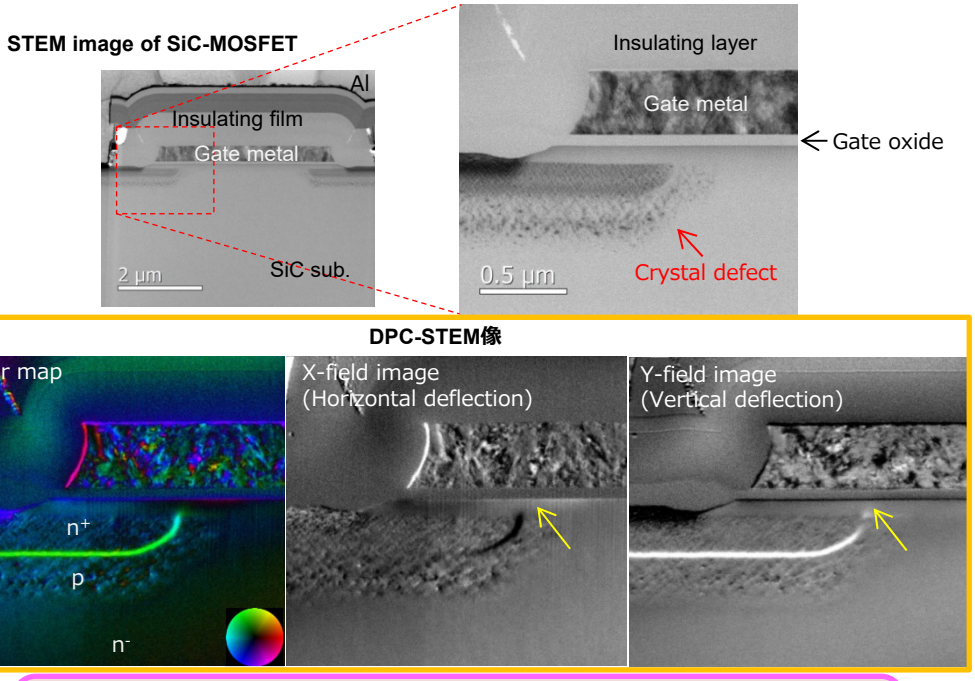
⇒**Carrier distribution and concentration can be characterized.**

Evaluation of p-n junction in SiC epitaxial layer of SiC-MOSFET using DPC-STEM imaging



Conceptual schematic of DPC-STEM

The internal electric field of the p-n junction deflects the incident electron beam. Using the segmented type detector, the variation of the beam deflection appears as a variation of contrast in the image



・Crystal defects can be observed in the n+-and p-type layers.
・The p-n junction cannot be observed near the gate oxide.

⇒**Structure, crystal defect and p-n junction can be characterized with high spatial resolution.**

Toray Research Center, Inc.