JOHANNES KEPLER
UNIVERSITÄT LINZ

HABILITATIONSKOLLOQUIUM

in the field of ‚NANOTECHNOLOGY'

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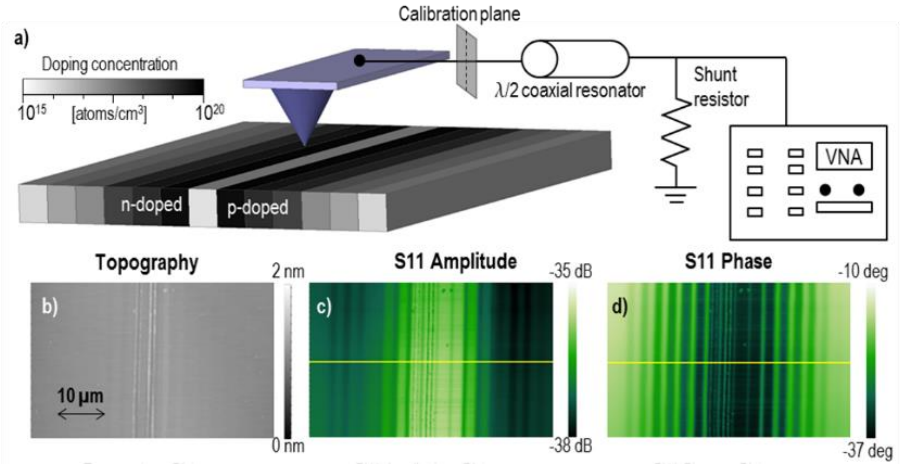
Keysight Research Labs Linz

Thursday, 4th of July 2019, 1:00 pm
JKU main campus, Room HS 14 (TNF Tower)

High frequency nanoscale impedance studies of advanced materials

The high frequency electromagnetic properties of advanced materials are studied on the nanoscale by combining the AFM (atomic force microscope) with the VNA (vector network analyzer) (see Figure of AFM-VNA on a silicon dopant sample). The method was developed to achieve highly sensitive and calibrated measurements of complex impedance that are traceable to international metrology standards, establishing a reliable technology basis for high resolution studies of semiconductors, bio-materials, and energy devices [1]. For semiconductors, dopant profiling in silicon revealed capacitive properties of the depletion zone with 20 nm resolution [2]. Due to the capability of the electromagnetic GHz wave to penetrate from the surface into the bulk of the sample, the method can be used to measure sub-surface features, as shown on semiconductor devices and single atom-thick dopant layers in silicon [3]. For biology, the conductance of the cell membrane was measured, and water dielectric properties were characterized at 20 GHz where water shows a dielectric relaxation [4]. The high frequency impedance measurement was also adapted for bio-detection of antibodies and viruses with high sensitivity [5]. Currently, the focus is on applying the high frequency materials characterization towards electrochemical interfaces to study redox-reactions in the nanoscale thick SEI (solid-electrolyte interphase) layer of batteries for high-throughput production.



References:
[1] Rev. Sci. Instr. 81 (2010) 113701
[2] J. Appl. Phys. 111 (2012), 014301
[3] Nanotechnology 26 (2015), 13. Cover story.
[4] Nanotechnology 27 (2016), 135702
[5] Biosensors 6 (2) (2016), 23

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