Nanotek-2013

OMICS Group Conferences
Accelerating Scientific Discovery

3rd International Conference on
Nanotek & Expo

December 2-4, 2013 Las Vegas, USA

Mapping electric, magnetic and strain nanofields by off-axis electron holography: Prospects and problems

Jan Sickmann

Technische Universitaet Dresden, Germany

Abstract

Off-axis electron holography provides access to the phase of the object-modulated electron wave mostly invisible in a transmission electron microscope. Since the phase shift of an electron wave is considerably more sensitive to intrinsic electric and magnetic fields than the amplitude, it serves as the key observable for mapping such object properties on the nanoscale. Measuring potential distributions in silicon based devices and polarization in magnetic domains, like in magnetic shape alloys, nowadays ranks among standard applications in off-axis electron holography. As an extension of this 2D analysis technique, we present 3D reconstructions by electron holographic tomography enabling direct measurement of the electrostatic potential without the drawbacks of 2D imaging, e.g. thickness determination and projection effects. In fact, it allows the precise determination of charge carrier concentration of electrons and holes across p-n junctions at nanometer scale. Mapping strain fields in advanced semiconductor devices is considered to be another powerful application in off-axis electron holography. Since the phase of the diffracted wave is proportional to the displacements in a strained lattice, it provides direct access to local changes in the lattice parameter, leading to a 2D strain map. To emphasize the reliability of this application, we present strain measurements on state-of-the-art MOS transistor structures and use finite-element-simulations to confirm our results. Since a quite new application in electron holography exists in the field of in-situ observation of biased p-n junctions or illuminated solar cells, we will present some early results on this.

Biography

Jan Sickmann is currently completing his PhD in physics at Triebenberg Laboratory, a division of the Institute of Structural Physics at Dresden University. He has been working on electron holography for four years. In his diploma thesis he developed advanced holography setups for mapping electric fields in semiconductor devices. Currently, he is working in the field of strain mapping in transistor structures within a research project of the European Union, the State of Saxony and GLOBALFOUNDRIES Dresden.