

HL 26: Interfaces/surfaces

Time: Tuesday 16:00–17:00

Location: H14

HL 26.1 Tue 16:00 H14

Exact solution for the capacitance of a current-free Schottky diode — ●MATTHIAS SCHMIDT, HOLGER VON WENCKSTERN, RAINER PICKENHAIN, and MARIUS GRUNDMANN — Universität Leipzig, Institut für Experimentelle Physik II, Halbleiterphysik, Linnéstraße 5

C-V measurements on Schottky diodes are a widely used technique to determine doping profiles and barrier heights of the sample. Commonly the Schottky approximation (completely depleted space charge region) is assumed to be valid. This is not the case for moderate forward bias. We present an exact solution for the capacitance of a homogeneously doped space charge region considering free carriers. Within the framework of this solution the free carrier concentration in the bulk material of a Schottky diode can be extracted from C-V data measured at different temperatures. The theoretical results will be used to evaluate experimental data.

HL 26.2 Tue 16:15 H14

Polarity of Space Charge Fields in Second-Harmonic Generation Spectra of Si(100)/SiO₂ Interfaces — ARMIN RUMPEL¹, BASTIAN MANSCHWETUS¹, GERHARD LILIENKAMP¹, HARALD SCHMIDT², and ●WINFRIED DAUM¹ — ¹Institut für Physik und Physikalische Technologien, TU Clausthal, Leibnizstr. 4, D-38678 Clausthal-Zellerfeld — ²Institut für Metallurgie, TU Clausthal, Robert-Koch-Str. 42, D-38678 Clausthal-Zellerfeld

Optical second-harmonic generation (SHG) spectra of Si(100)/SiO₂ interfaces exhibit characteristic differences for positively or negatively charged space charge regions (SCRs). These differences originate from interference of second-harmonic light generated in the SCR with that generated by Si atoms in the immediate proximity to the oxide, and characterize the direction of the electric field of the SCR. The spectra are analyzed and modelled by Si interband resonances of the interface and of the SCR. The sensitivity of SHG to the polarity of the space charge is demonstrated for the negative space charge at alkali-modified Si(100)/SiO₂ interfaces, and for the positively charged accumulation layer caused by laser-induced surface traps in thin oxides. The shape of SHG spectra of Si(100)/SiO₂ interfaces in the 3.3-3.8 eV energy range is a signature of the sign of the prevailing interface/oxide charge at silicon interfaces.

HL 26.3 Tue 16:30 H14

Noninvasive Detection of Alkali Metal Ion Contaminations of Si(100)/SiO₂ Interfaces by Optical Second-Harmonic Generation — ●ARMIN RUMPEL¹, BASTIAN MANSCHWETUS¹, GERHARD LILIENKAMP¹, HARALD SCHMIDT², and WINFRIED DAUM¹ — ¹Institut für Physik und Physikalische Technologien, TU Clausthal, Leib-

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Optical second-harmonic generation (SHG) is demonstrated as a non-destructive probe of alkali metal ion contaminations in Si(100)/SiO₂ gate oxide systems. Accumulation of sodium or potassium ions in the near-interface region of the oxide leads to a strong resonant enhancement of the SHG signal between 3.2 eV and 3.8 eV. This enhancement is caused by dc-electric-field-induced SHG in a negatively charged space charge region of the semiconductor. The temperature dependence of the SHG signal from a potassium-contaminated Si(100)/SiO₂ system, measured for a two-photon energy of 3.3 eV, exhibits a slow initial decrease followed by a steep rise of the signal at a temperature of about 380°C. The decrease of the signal is caused by the temperature dependence of the E_1 interband resonance while the strong increase indicates the onset of potassium diffusion from the surface of the oxide to the near-interface region. The accumulation of potassium near the Si(100)/SiO₂ interface of the heated sample has been verified by SIMS measurements.

HL 26.4 Tue 16:45 H14

electron microscopy on axiotaxy of CrSi₂ on Si(001) - from the micrometer- to the angstrom-scale — ●MEIKEN FALKE¹, FRANK ALLENSTEIN¹, OLGA FILONENKO¹, GUNTER BEDDIES¹, STEFFEN SCHULZE¹, MICHAEL HIETSCHOLD¹, KOEN DE KEYSER², and CHRISTOPHE DETAVERNIER² — ¹Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — ²Universiteit Gent, Dept. of Solid-state Science, Krijgslaan 281/S1, 9000 Gent, Belgium

A recently [1] identified new type of thin film texture, the so-called axiotaxy, was found in thin CrSi₂ films on Si (001) substrate. The films were grown under UHV conditions by MBE using a thin template. Two different epitaxial orientations forming additional domains respectively were identified using TEM and XRD. Additionally, EBSD and XRD pole-figures show a considerable part of the silicide film to consist of small crystallites with a texture axis inclined to the substrate. This texture with the rotation axis different from the substrate surface normal, called axiotaxy, provides one-dimensional periodicity at the crystallite substrate interface which seems to be energetically preferred and representing an initial growth state, probably common in many thin film systems. In particular CrSi₂ planes with plane distances close to the Si (110)-type distance are parallel to the four on Si(001) possible (110)-type substrate planes. The one-dimensional periodicity at the interface was investigated by conventional high resolution and aberration corrected transmission electron microscopy.

[1] C. Detavernier et al., Nature 426 (6979): 641-645 DEC 11 2003