# DS 2: Thin Film Characterisation: Structure Analyse and Composition (XRD, TEM, XPS, SIMS, RBS, ...) II

Time: Monday 14:00–15:30 Location: GER 37

DS 2.1 Mon 14:00 GER 37

**Nickeldotierung von Diamantnanokristallen zur Erzeugung robuster Einzelphotonquellen** — •Marco Wolfer[2], Armin Kriele[1], Oliver Williams[1], Harald Obloh[1], Crenguta-Columbina Leancu[1], Lutz Kirste[1] und Christoph Nebel[1] — [1]Fraunhofer-Institut für Angewandte Festkörperphysik, Tullastraße 72, 79108 Freiburg i. Br. — [2]Albert-Ludwigs-Universität Freiburg, Fakultät für angewandte Wissenschaften, Georges-Köhler-Allee101, 79110 Freiburg

Farbzentren in Diamant haben sich als robuste Quantenemitter erwiesen und stellen aufgrund ihrer niedrigen Linienbreiten und hohen Repeditionsraten die Basis für eine Vielzahl zukünftiger opto-elektronischer Anwendungen dar (Quantenkryptographie, Quantencomputer, optische Transistoren). Ein besonders attraktives Single-Photon Zentrum ist der Nickel-Stickstoffkomplex $NiN_x$, dessen reproduzierbare Erzeugung sich allerdings als sehr schwierig darstellt. Gegenstand der vorliegenden Untersuchung ist die gezielte Nickeldotierung von dünnen Mikrowellen-Plasma-CVD abgeschiedenen Diamantschichten. Als Dotierquellen werden benutzt: a) gasförmiges Nickelocene, b) Nickelpulver, das zu Diamant-Nanopartikeln hinzu gemischt wird und c) Nickeldraht. Alle drei führen zu einer Anreicherung des Wasserstoffplasmas mit Ni Atomen was mit optischer Emissionsspektroskopie nachgewiesen wird. Der substitutionelle Einbau von Nickel in die Diamantstruktur wird mittels Photolumineszenz, konfokaler Mikroramanmikroskopie und SIMS untersucht. Die Ergebnisse dieser Dotierversuche werden im Detail vorgestellt und diskutiert.

DS 2.2 Mon 14:15 GER 37

**Texture analysis on the system $Mn_4Si_7$@Si(001): Combining statistical and microscopical information** — •Herbert Schletter[1], Steffen Schulze[1], Michael Hietschold[1], Koen De Keyser[2], Christophe Detavernier[2], Gunter Beddies[1], and Meiken Falke[1,3] — [1]Institute of Physics, University of Technology, 09107 Chemnitz, Germany — [2]Department of Solid State Physics, Ghent University, Belgium 9000 — [3]at present Bruker AXS, Germany

Higher manganese silicides (HMS) are promising candidates for opto- and thermoelectrical applications. They are stable, environmentally friendly and cheap. Since these materials show a strong anisotropy in their electrical properties, it is important to know the texture of HMS thin films on silicon. The system $Mn_4Si_7$@Si(001) was investigated with electron backscatter diffraction (EBSD) to reveal both, statistical information on crystallite orientation (i.e. texture) and microscopical information on crystallite sizes.

Besides the known epitaxial orientations of this system, new texture components were found, including epitaxial and axiotaxial relations. The latter component (which can be described as an off-normal fibre texture) is of special interest since it has been known for only few years and has been investigated on a small number of materials up to now.

By combining the statistical and microscopical information provided by EBSD, a correlation between the respective texture components and the grain size could be drawn, which showed, that the degree of periodicity at the interface strongly influences the size of the growing crystallite.

DS 2.3 Mon 14:30 GER 37

**Studies of interdiffusion and magnetism in magnetic multilayers** — •Mathias Schmidt, János Major, Adrian Rühm, Márton Major, Max Nülle, and Helmut Dosch — Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart

Strongly reflecting so-called supermirrors are frequently used in neutron optics in many ways, for example in neutron guides or as magnetic polarizing mirrors. They consist of aperiodic multilayers of two materials with a layer thickness in the nanometer range. The properties of such multilayers are strongly dependent on the quality of the interfaces (geometrical and magnetic roughness, intermixing). Irregularities usually are introduced in the production phase. To improve the understanding of the technological processes, we investigated the interdiffusion of the components in periodic Ni-Ti and Fe-Si multilayers. The samples were annealed at different temperatures from 100°C to 300°C and neutron and x-ray reflectivity and neutron off-specular scattering experiments have been performed. In the case of the Fe-Si samples, the neutron experiments were performed also in spin-resolved mode. The results of the experiments, their detailed analysis and the obtained annealing-dependent interface roughnesses (chemical and magnetic), as well as the interdiffusion properties of the samples will be presented.

DS 2.4 Mon 14:45 GER 37

**Non-destructive speciation of buried nanolayer systems by angle-corrected GIXRF-NEXAFS** — •Beatrix Pollakowski and Burkhard Beckhoff — Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin

The photon-in photon-out spectroscopic method GIXRF-NEXAFS[1] has proved to be a reliable tool for the non-destructive analysis of deeply buried single layers. In recent investigations even species of buried double layer systems, consisting of different bonds of the same element were addressed. This approach becomes relevant for the characterization of interfaces or gradient layers as alternative methods may involve drawbacks such as sample modifications by sputtering or limited information depths. The intensity of the x-ray standing wave (XSW) field determining GIXRF characteristics is to be well known for each kind of layered material to keep the mean penetration depth constant in the respective layer of interest. Moving on, one may even keep the XSW intensity constant in only one part of a buried nanolayer, thus providing access to interfaces by a differential approach employing angle-adapted NEXAFS.

The double layer systems investigated consist of a titanium oxide ($TiO_2$ or $Ti_2O_3$) and metallic Ti layer, separated from each other by a 2 nm C layer. First GIXRF-NEXAFS measurements at the Ti-$L_{iii,ii}$ absorption edges with angular correction based upon prior XSW simulation demonstrate the high potential of the approach for analyzing novel materials nanolayers.

[1] B. Pollakowski et al., Phys. Rev. B **77**, 235408 (2008)

DS 2.5 Mon 15:00 GER 37

**Channeling irradiation of $LiNbO_3$: Influence of ion energy and ion species** — •Tobias Steinbach, Frank Schrempel, Thomas Gischkat, and Werner Wesch — Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena

Ion irradiation of $LiNbO_3$ causes the formation of defects due to nuclear as well as electronic energy deposition $\epsilon_n$ and $\epsilon_e$, respectively. However, the defect formation is influenced by the orientation of the crystal. In order to investigate the effect of $\epsilon_n$ and $\epsilon_e$ on the damage formation x-cut $LiNbO_3$ single crystals were irradiated on- and off-axis using $Si^+$ and $Cu^+$ ions with energies ranging from 550 keV to 2 MeV. We demonstrate for on-axis irradiation that at low ion energies where $\epsilon_n$ dominates the formation of defects, the defect distribution is shifted to larger depths compared to off-axis irradiation. The investigation of the shift shows a square-root dependence on both ion energy and ion species. Furthermore, on-axis irradiation was done using high-ion energies where defects are formed in the near-surface region due to electronic energy loss. Compared to off-axis irradiation a thinner amorphous surface layer was formed as a result of the reduced electronic energy loss in the case of on-axis irradiation. For on-axis irradiation $\epsilon_e$ has been estimated in two different ways considering the layer thickness and the penetration range of the incident ions.

DS 2.6 Mon 15:15 GER 37

**Gracing incidence FTIR of thin high-k dielectrics** — •Wenke Weinreich[1], Johannes Müller[1], Martin Rose[1], Lutz Wilde[1], Martin Lemberger[2], Marco Steinert[3], and Uwe Schröder[3] — [1]Fraunhofer CNT, Dresden, Germany — [2]Fraunhofer IISB, Erlangen, Germany — [3]Qimonda, Dresden, Germany

High-k dielectrics are under intensive study for transistor and memory applications. The crystallinity mainly determines the permittivity and, thereby, the electrical performance of the built capacitor. We will present a new method that uses a common Fourier transform infrared spectroscopy (FTIR) in a gracing incidence configuration to investigate the crystallization behaviour of thin 6 to 10 nm dielectric films. The advantage of this standard FTIR technique is the enhanced spectral range compared to attenuated total reflection (ATR)-FTIR which

is generally used to analyze especially thin films. More precisely, the required ATR-FTIR method for dielectrics would only provide 670 $cm^{-1}$ as minimum wavelength. In this study, ideal measuring settings for standard FTIR are identified and the investigation of thin films annealed at various temperatures is performed. Phase analysis, crystallization temperature and the influence of doping concentration on the structure of dielectrics and, especially, on the phase stabilization are determined. The studied material systems are Al- or Si-doped $ZrO_2$ and $HfO_2$, and also $TiO_2$ grown by atomic layer deposition. It will be shown that the analysis can be done on different substrates if suitable references for the background measurement are available. The obtained results are correlated to gracing incidence X-ray diffraction.