JOHANNES KEPLER
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Im Rahmen des Physikkolloquiums spricht

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über

Transmission Electron Microscopy: Beyond Imaging – Phase decomposition and defects in semiconductors and steel

The transmission electron microscope (TEM) is an indispensable tool for modern material research. While it is often used "*only*" for sample imaging to learn about the morphology and structure of a material, TEM shows its real power when crystallographic, chemical, and atomic-resolved information are combined with nanometer resolution.
In this talk, I will show how electron microscopy has been employed to understand self-organization, decomposition and defect formation in the semiconductor systems PbTe/CdTe and Si-Ge-Sn through *in-situ* experiments [1], which leads to a better understanding of the occurring processes. Employing high-resolution TEM, precise atomic position information was gained to clarify the atomic structure of interfaces, defects and to determine strain states. Diffraction contrast imaging and especially convergent electron beam diffraction are best suited for highly precise crystallography, to characterize dislocations and dislocation reactions [3]. I will show for different SiGe systems, how relaxation mechanism and dislocation reactions are influenced by different sample geometries. The presented methods are also best suited for metals like austenitic high-Mn-steels to reveal dislocations and twinning mechanisms [4].

Goal of the actual work that is currently taking place in the frame of the newly founded Christian Doppler Laboratory is to adapt and apply these analytical techniques to complex multiphase materials like modern ultra-high-strength steel and steel coatings. For these materials, the above-mentioned methods represent an indispensable tool to investigate different topical problems, like phase and oxide formation in modern Zn-coatings and weakening of grain boundaries by liquid-metal embrittlement.

[1] H. Groiss, M. Glaser, M. Schatzl, M. Brehm, D. Gerthsen, D. Roth, P. Bauer, F. Schäffler, Scientific Reports **7**(1), 1–12, (2017)

[2] H. Groiss, M. Glaser, A. Marzegalli, F. Isa, G. Isella, L. Miglio, F. Schäffler, Microscopy and Microanalysis **21**(3), 637–645, (2015)

[3] P. Kürnsteiner, C. Commenda, E. Arenholz, L. Samek, D. Stifter, H. Groiss, Materialia **1**, 70–77 (2018)

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