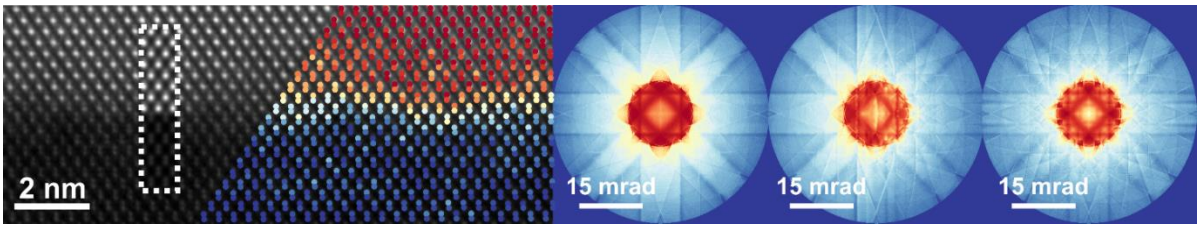
Smaller, faster, more efficient?



Experimentally measured and simulated structure of the galliumphospide/silicon-interface at atomic resolution. Electron diffraction patterns allow to determine the interfacial charge distribution.

Today, modern electronics, mobile phones, computers and solar cells to name a few, are integral to everyday life. Yet, these silicon-based devices are increasingly reaching their performance limit: computing speed barely increases; solar cell efficiency is hardly on the rise.

One option to overcome these largely physics-based limitations is to cover silicon with a different material layer like, for example, well-suited III/V semiconductors (containing elements of the 3rd and 5th group of the periodic system). However, preparation of these new, combined structures is challenging.

In joining different materials with their individual physico-chemical properties their interface may be marked by defects. Here, for example, "erroneous" attachments may lead to unwished-for local charges – rendering the combined material as unsuitable for application in devices.

Scientists at Philipps-Universität Marburg were recently invited to publish their research, conducted with financial support as part of the collaborative research center SFB 1083 *"Structure and Dynamics of Internal Interfaces"* of the German Research Foundation and the *MehrSi joint-project* of the Federal Ministry of Education and Research (BMBF) to publish a review of their experimental results on the structure of III/V semiconductors on silicon in the journal *Advanced Materials Interfaces*.

Researchers in the group of Prof. Kerstin Volz closely studied galliumphosphide on silicon as a model system. In their review the authors describe various electron-microscopy-based approaches to studying the internal interface between the two materials and its defects.

"It is especially transmission-electron microscopy which yields insights into material structures at the atomic scale", says Kerstin Volz. It is with this method that the researchers were able to show that the interface between the two materials is far from smooth; in fact, it more resembles a pyramidal structure affecting several atomic layers. In addition, it was also possible to "see" the erroneous atomic attachments which cause the unwished-for charge effect and link the phenomenon directly to changes in preparatory procedures.

The insights gained will now be applied to perfecting preparation methods to reduce the number of defects and fine-tuning the interface with a focus on raising the efficiency of existing devices and encouraging the development of novel applications.

Publication:

A. Beyer & K. Volz, *Quantitative Electron Microscopy for III/V on Silicon Integration*, Advanced Materials Interfaces (2019) 1801951 DOI:10.1002/admi.201801951

Contact:
Prof. Kerstin Volz
Philipps-Universität Marburg
Wissenschaftliches Zentrum für Materialwissenschaften & FB Physik
Email: kerstin.volz@physik.uni-marburg.de