Business idea

Software for the simulation of electronic and optoelectronic semiconductor nanodevices

Vision

"To establish the next**nano** software as the de facto standard simulator for the next generation of electronic and optoelectronic semiconductor nanodevices."

Founder

Dr. Stefan Birner studied Physics at the universities of Bayreuth (Germany), Exeter (UK), Ohio State (USA) and the Technische Universität München (Germany). During his studies, he gained experience through internships at companies such as Infineon Technologies and Genius CAD-Software.

Stefan holds a **Master of Physics** degree from the University of Exeter and a **PhD** in Physics from the Technische Universität München where he worked at the Walter Schottky Institute in the field of Theoretical Semiconductor Physics under the supervision of Prof. Peter Vogl. He has several years of international experience in the field of semiconductor simulation. Through competent partners at universities he has access to a large network of know-how in this field.

After having received financial support through the EXIST-SEED program "University-based start-ups" of the German Federal Ministry of Education and Research (BMBF), Stefan founded in October 2012 the next**nano** GmbH where he serves as the CEO since November 2012.

Applications

Quantum cascade lasers, quantum dots, nano-MOSFETs, strained silicon, LEDs, laser diodes, infrared detectors, biosensors, …

Disruptive technologies

The next**nano** GmbH acts in new markets: nanowires, biochips, efficient solar cells, nanocrystals, gas sensors, spintronics, quantum computing, …

Executive Summary

The business idea of the next**nano** GmbH is the development of software for the simulation of electronic and optoelectronic semiconductor nanodevices and materials (e.g. transistors, resonant tunneling diodes, quantum dots, quantum wires, quantum cascade lasers). Due to the continuing scaling of semiconductor electronics, quantum physical effects are gaining importance and fundamentally challenge industry with respect to simulation and design.

Our unique selling proposition is an advanced physical method for the calculation of the **quantum mechanical properties** of an arbitrary combination of geometries and materials. The next**nano** software is not limited to certain types of devices and thus perfectly suited for both, currently existing devices and novel devices, like for instance protein sensors (biochips). Our customers benefit from faster (time-to-market) and cheaper development of devices.

The next**nano** GmbH is a spin-off from the Walter Schottky Institute of the Technische Universität München, Germany (former Chair for Theoretical Semiconductor Physics, Prof. Peter Vogl).

Customers

Our customers are the research labs of the leading semiconductor companies. Numerous top-notch universities are among our customers.

Customers' benefits

- better understanding of device physics
- systematically improve and optimize devices
- less redesign cycles (optimum prototype)

Customer feedback

*"One reason that the next**nano** software is so good at nanoelectronics is that it was not designed for nanoelectronics. It was designed to do physics."*

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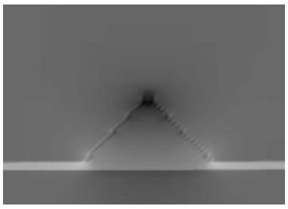
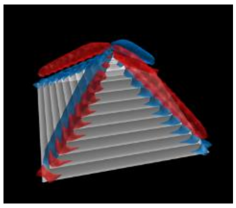
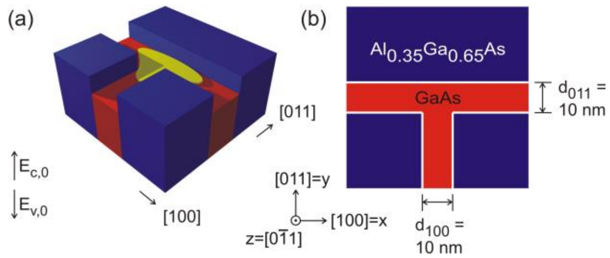
3D quantum dot



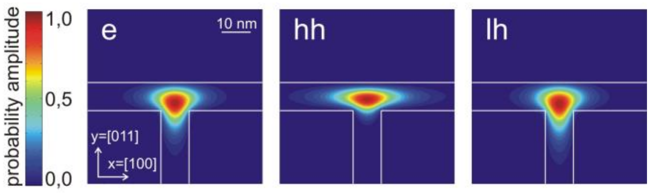


Left: Cut through the quantum dot: The bright line represents a layer of three atomic layers of InAs. Below this InAs layer the substrate material GaAs is located. The different lattice constants of GaAs and InAs lead to strain which causes self-organized growth of quantum dots. The InAs pyramid is surrounded by GaAs.
(bright colors: compressive strain, dark color: tensile strain – as calculated with next**nano**.)
Right: Due to the strain, strong piezoelectric fields arise at the edges of the pyramid which affect the optical properties of the dot.

2D quantum wire

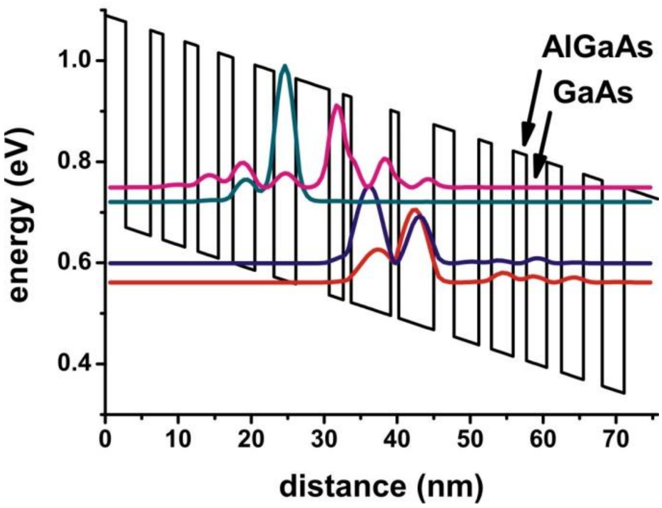


The figure on the left (a) shows schematically the conduction band profile of a T-shaped quantum wire. The schematic on the right (b) shows the relevant dimensions and materials.



In this figure the calculated wave functions of the electron (e), heavy hole (hh) and light hole (lh) are shown.

1D quantum wells (quantum cascade laser)



Conduction band structure of a quantum cascade laser including the most important electron wave functions.