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S E M I N A R

aus

Halbleiterphysik und Nanotechnologie

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Hörsaal für Physik

"Silicon-Germanium Alloys: From Physics to Applications"

em.Univ.Prof. Dr. Günther Bauer

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In this talk an overview will be presented how basic physics studies on silicon-germanium alloys have contributed to advance semiconductor device engineering, both in electronics as well as in photonics. In 2003 Germanium has been introduced into main stream Si technology for the fabrication of integrated circuits and has been used ever since. Due to the different lattice constants of Ge and Si mechanical strain is introduced which reduces the crystal symmetry and thus leads to a modification of the electronic band structure. This is used to enhance e.g. the carrier mobility in electronic CMOS devices and has been essential for the continued validity of Moore's law up to now. In industrial devices based on planar technology, the maximum strain values employed are about 0.5%. However, in Si-layers on top of three-dimensional SiGe islands strains above 1% can be achieved to further enhance the characteristics of field effect transistors. Synchrotron x-ray diffraction experiments with focused x-ray beams were used to determine the strain distribution even in a single working transistor. Strain engineering is at present also the method of choice in silicon based photonics which holds the promise to integrate electronic and photonic functionalities on a silicon platform. Whereas Si and SiGe based light detectors can be easily fabricated, lasers have so far been elusive. However, recent progress with tensile strained Ge has opened an avenue for achieving an electrically pumped Ge laser on Si.