SFB-Kolloquium

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Thema: New crystal phases in semiconductor nanowires: a platform for phonon engineering and for magneto-optical studies

Abstract
If the capability to control photons and electrons in crystals has brought to an astonishing level of knowledge as well as to extraordinary technological achievements, the manipulation of phonons is still quite unexplored, despite it holds the promise of a quantum-mechanical control of heat transport. The quantum-mechanical behavior of phonons may also enable the realization of coherent phonon transport via phonon engineering. Nanostructures, such as semiconducting nanowires (NWs), are an ideal platform for phonon engineering, since they offer the possibility to modify to a large extent the phonon properties by enabling the formation of different kinds of superlattices. Indeed, III-V NWs display a unique property, which is the existence of polytypism, namely the possibility to grow in zincblende (ZB) or wurtzite (WZ) crystal phase. This has widened the potential applications of technologically relevant III-V compounds such as GaAs, InP, and GaP, for which WZ does not exist in bulk form. The controlled switching between different crystal phases during the NW growth opened the way to crystal phase engineering and to the formation of novel types of superlattices. I will show how the phononic properties can be decided à la carte by tuning the superlattice period in NWs, as demonstrated by Raman spectroscopy, and discuss the future developments in thermal transport.

The second part of the talk will be focused on optical and magneto-optical properties of nanowires in the poorly known WZ crystal phase. The knowledge of the value and anisotropy of the carrier mass and g-factor is crucial for the potential applications of NWs in several fields, such as solar cells, thermoelectric devices, spintronic, and quantum computation, and can also provide insightful information about the symmetry characteristics of the underlying electronic structure. We present a complete experimental and theoretical investigation of the Zeeman splitting (ZS) of the fundamental exciton transition in WZ InP NWs by photoluminescence measurements under magnetic fields up to 30 T directed along different NW crystallographic directions. Our study solves the puzzle of the nonlinear ZS found in several III-V WZ NWs comprising even GaAs and InAs.

Gastgeber: Dr. Paulo De Faria Junior