

Optical Properties of Semiconductor Quantum-Wells

Optische Eigenschaften von Halbleiter-Quantenfilmen

Gallium-arsenide (GaAs) is not only the material of choice for producing high-frequency electronic semiconductor devices (e.g. the High Electron Mobility Transistor (HEMT)) used in wireless telecommunications, it also plays an important role in basic research on semiconductors. In particular, combining GaAs layers with other materials such as aluminum-arsenide (AlAs) or indium-arsenide (InAs) opens a wide playground for the investigation of interesting modern physical phenomena.

In this experiment we will examine a crystal hosting alternating layers of AlGaAs and GaAs. These layer sequences — referred to as AlGaAs/GaAs heterostructures — grown by molecular beam epitaxy (MBE) show an interesting behavior: If a GaAs layer sandwiched between AlGaAs layers is thin enough, it confines charge carriers in one dimension resulting in a two-dimensional quantum mechanical system, a quantum well. The optical properties of this quantum well are investigated by optically generating electron-hole pairs in the corresponding bands and having a close look at the light emitted due to recombination of the charge carriers. From the measured spectra we will deduce the thickness of quantum wells in a unknown sample as well as draw conclusions on the crystal quality of the grown layers.

In this experiment we will learn and exercise different techniques as photoluminescence, arranging and adjusting optical components such as mirrors and lenses, and cooling samples down to low temperatures.