Abstract

In this thesis two-dimensional electron systems and InAs quantum dots in semiconductor heterostructures are studied by magneto-transport measurements and capacitance spectroscopy. In the capacitance spectra the quantum dots, which were embedded in so called MIS (metal insulator semiconductor) structures, reflect the effect of coulomb blockade as well as the s- and p-shell of their energy levels spectrum. These features are also found in quantum dots embedded in a modified MIS structure equipped with a two-dimensional electron gas, which forms the backgate. Both MIS-structures are compared with respect to different parameters in the capacitance measurement.
The two-dimensional backgate is investigated by magneto-transport measurements at very low temperatures.

Many-particle effects in the thermodynamic density of states of a two-dimensional electron gas with high mobility at small densities are observed by use of a special field penetration technique. An effect, which is possibly the result of resonant tunneling between two two-dimensional electron systems, is investigated in a magnetic field applied in different orientations with respect to the sample. Those effects are not observed in a sample, whose growth process was interrupted in the channel of the two-dimensional electron gas.

Further more a two-dimensional electron system is investigated, whose transport properties in a magnetic field is affected by metallic stripes, that are periodically arranged on the sample surface. Typical effects like commensurabillity oscillations are observed and their strong dependence on the orientation of the metallic stripes with respect to axis of the semiconductor crystal is established. The stripes are arranged in an interdigital manner and act as gates, i.e. different voltages can be applied to every second stripe. The potential modulation in the plain of the two-dimensional electron gas, which is induced by the charge on the gates, can be varied within a broad range without a significant change of the electron density. Taking into account mechanisms that damp the amplitude of the commensurability oscillations, the strength of the potential modulation is determined quantitatively and compared with different models for this system.