Abstrakt

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Title: Fabrication and transport in quantum low-dimensional semiconductor nanostructures from II-VI materials

Modulation doped Cd(Mn)Te structures studied in this dissertation combine the high mobility of two dimensional electron gas (2DEG) with the extremely large and tunable Lande g-factor, which makes such a quantum wells the material of choice for the construction of semiconductor spintronic nanodevices. This doctor thesis focuses on the fabrication of micro-structures from Cd(Mn)Te QW with the application of high-resolution electron-beam lithography, by developing the special low-temperature and non-invasive nano-patterning techniques, optimized for II-VI materials. In particular, the work describes the method of producing *side-gate* to control the conduction channel. As a results, the active area of the structure was not illuminated with high-energy electrons, as in the case of metallic *top-gate*. We demonstrate also, how to combine the shallow etching of separating grooves with a lift-off metallization procedure, into a single post-processing stage.

The second aim of this work is study low-temperature magneto-transport measurements performed on quasi-ballistic microstructures defined lithographically formed as a H- and T- shaped device. For both structures, the results of differential conductivity in low magnetic fields and low temperatures were presented. For T structure we have observed, so-called magnetic focusing, making it possible to selectively filling of spin states in the transverse electrode. For the H-structure, we analyzed the Shubnikov-de Haas oscillations with the characteristic beating pattern and we shown, that nodes of such pattern are shifted, when we change source- drain voltage V_{SD}.

The main result was obtained for the H-type structure, for a detailed analysis of quantum transport in a wide range of magnetic fields. At stronger fields ($B > 3T$), we have observed the very untypical (high and narrow) magnetoconductance peak related to the transition to quantum Hall ferromagnet (QHFM) state, occurring at the edges of the sample. We indicate, that separated edge currents which flow in parallel, may nevertheless cross at certain points, giving rise to the formation of *topological defects* or one-dimensional magnetic domains. Furthermore, we find that such *local crossing* of chiral channels can be induced on demand, for example by applying a DC source-drain voltage.