High mobility CdTe- and $Cd_{1-x}Mn_xTe$-based 2DEG nanostructures: from technology to applications in basic research and applied science *

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$Cd_{1-x}Mn_xTe$ is one of the most prominent and most thoroughly studied members of the family of diluted magnetic semiconductors, which are characterized by a gigantic enhancement of their all spin-dependent properties. However, recent application of $Cd_{1-x}Mn_xTe$ nanostructures for spin physics and applied research in the area of spintronic devices was impeded by the unavailability of high quality $Cd_{1-x}Mn_xTe$-based structures containing two-dimensional electron gas (2DEG).

I will summarize last years advances in molecular beam epitaxial technology of such structures that lead us to setting a new world record of 2DEG mobility for wide-gap II-VIs at the level of nearly 500 000 cm^2/Vs. The exceptional quality of structures was confirmed also by the observation of fractional quantum Hall effect (FQHE) not only in CdTe-QWs [1, 2], but also in DMS $Cd_{1-x}Mn_xTe$-QWs [1], with effective electron g-factors as high as 350. This was the very first observation of FQHE in II-VI semiconductor materials.

As a second part of the talk I will review up-to-date applications of such 2DEG CdTe- and $Cd_{1-x}Mn_xTe$-based quantum structures for:

- Demonstration that fully developed FQH states observed at filling factor 4/3 and 5/3 are both spin-polarized ground states for which the lowest energy excitation is not a spin flip [2].
- Observation of the enhancement of the spin gap in fully occupied two-dimensional Landau levels through simultaneous measurements of magneto-transport and magneto-photoluminescence in 2DEG CdTe quantum structures [3].
- Terahertz [4] and microwave [5] radiation induced generation of pure spin currents in DMSs.
- Demonstration of a new type of spin transistor action (other than in the well-known Datta Das design) in hybrid devices made of 2DEG DMS structures with metallic nanomagnets deposited on their surface [6].
- Demonstration of generation of terahertz radiation pulses from spin-waves optically induced in diluted magnetic semiconductor QWs [7].

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