II-VI Diluted Magnetic Semiconductor Nanostructures for Spintronic Research

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II-Mn-VIs are the best known and most thoroughly studied members of diluted magnetic semiconductors (DMSs) family, however, their modern applications in spintronic research was limited by the unavailability of appropriate nanostructures with sufficient quality. On the other hand one of the main advantages of II-Mn-VIs is that Mn in this class of materials is isoelectronic and does not lead to any drastic reduction of carrier mobility, as opposite to the case of III-Mn-Vs, where Mn in an acceptor.

In my talk I will review recent progress and present brief history of the spin related research performed on II-Mn-Te nanostructures produced in the Institute of Physics of the Polish Academy of Science in Warsaw. This will cover two-, one- and zero-dimensional nanostuctures based on ZnMnTe and CdMnTe DMSs.

I will start by shortly presenting the results on MBE technology and studies of CdMnTe self-assembled quantum dots and ZnMnTe-based nanowire structures produced with the use of gold-assisted vapor-liquid-solid growth mechanism [1].

Then I will concentrate on recent progress in MBE technology of telluride nanostructures containing two dimensional electron gas (2DEG) that lead to the observation of fractional quantum Hall effect not only in nonmagnetic CdTe quantum wells [2], but also for the first time ever in magnetic system (based on CdMnTe) [3]. This, interesting by itself, opens new perspective for the applications of such II-VI DMS nanostructures in both basic and applied research in the field of spintronics. After shortly describing the technological steps undertaken to bring the quality of MBE-grown CdMnTe nanostructures to the current level, I will discuss already demonstrated applications of such high mobility magnetic-2DEG for:

- THz and microwave radiation induced zero-bias generation of pure spin currents and very efficient magnetic field induced conversion of them into spin polarized electric current [4].
- Clear demonstration of THz radiation from spin-waves excited in DMS via efficient Raman generation process [5].
- Experimental demonstration of working principles of a new type of spin transistor based on controlling the spin transmission via tunable Landau-Zener transitions in spatially modulated spin-split bands [6].
- Unambiguous observation and quantitative determination of an enhancement of spin-orbit field in collective spin excitations [7].

The research was partially supported by National Centre of Science (Poland) grant DEC-2012/06/A/ST3/00247 and by the European Union within European Regional Development Funds, through the Innovative Economy Grant POIG.01.01.02-00-008/08.

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