Scanning Kerr rotation measurements of etched channels in CdTe quantum wells

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Low dimensional heterostructures based on cadmium telluride, especially those doped with Mn, are intensively studied for possible applications in optoelectronics (due to its direct band gap and near infrared to visible emission) as well as in spintronics (current induced spin polarization and spin filtering). In both cases the properties of final devices can be controlled via quantum confinement and structure engineering. For investigations of spin-induced effects a fabrication of high quality electronic microdevices is especially important.

In this paper we concentrate on preparation and measurements of spatially-resolved Kerr effect of conducting micro-channels etched in n-type CdTe/CdMgTe quantum well grown by MBE technique. To achieve high electron spin density in the region of quantum well the samples were modulation-doped with iodine up to carrier concentration of about 1.2×10^{12} cm^{-2}. Investigated devices were designed as shown in Fig.1 using electron beam lithography and wet etching to define conducting channels. The samples with different width of micro-channels were prepared (20, 50, 100 and 150 μm). The measurements of Kerr rotation microscopy were performed in wide range of temperatures from 10 to 300 K using He-Ne laser light (λ=632.8 nm). At room temperature we observe no change of Kerr signal when moving the spot of light across the region of conducting channel. We start to observe the change of light polarization near the edge of our micro-devices at temperatures of about 78 K. At temperature of 10 K this change exhibits asymmetric behavior similar to that observed for spin Hall effect [1]. However, in the case of our samples this change is observed without external electric field applied to the micro-wire. Our results will be discussed taking into account the diffusion current induced by Seebeck effect due to local heating of the conducting channel by laser light and possible electron spin polarization resulting from spin Hall effect in two-dimensional electron gas.

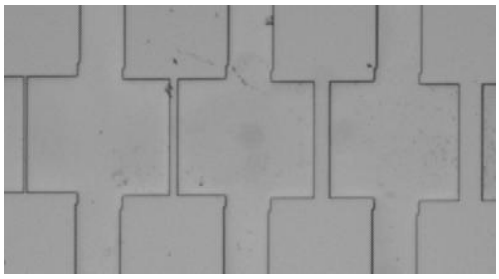

Fig1. Optical image of etched conducting micro-channels witch diameter 20, 50, 100 and 150 μm prepared in CdTe QW.

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[1] V. Sih, R. C. Myers, Y. K. Kato, W. H. Lau, A. C. Gossard, D. D. Awschalom, Nature Physics vol 1, 31–35 (2005).