Towards high mobility 2DEG in CdTe quantum wells doped with Indium

R. Rudniewski[1,2], W. Zaleszczyk[1,2], M. Wiater[1], Z. Adamus[1], T. Wojciechowski[1,2], T.Wojtowicz[1,2]

[1]Institute of Physics Polish Academy of Sciences, PL-02668 Warsaw, Poland
[2]International Research Centre MagTop, PL-02668 Warsaw, Poland

We present comparative studies of CdTe QWs modulation doped with either Iodine or Indium donors. Previously Iodine, which substitutes for Te atoms in CdTe lattice, was recognized as an optimal dopant for producing ultra-high mobility CdTe-based 2DEG structures. However Iodine strongly segregates towards growing surface and ultra-high mobility 2DEG can only be obtained if Iodine is introduced after the growth of QW, into the top barrier that is closer to the surface. On the other hand structures doped prior the growth of QW would be better suited for the gate controlled creation and manipulation of non-Abelian excitation [1]. Here we present results of our research aiming at producing high mobility CdTe structure with the use of Indium donors, which substitutes for Cd. It was believed that segregation of Indium will be much smaller than that of Iodine. However, it was not clear to what extent the fact that Indium atoms form DX-like centers will limit their usefulness to be used in CdTe/CdMgTe modulation doped structures. To our knowledge there were no previous reports on Indium modulation doped CdTe-based structures published.

We grew a series of structures with different fluxes, flux ratio and various substrate temperatures. Reflection high-energy electron diffraction (RHEED) was used to determine a growth rate and evaluate smoothness of grown layers. The samples were post-growth characterized using (i) scanning electron microscopy - to confirm thickness and check the smoothness of grown surface; (ii) photoluminescence - to determinate energy gaps of different layers and their composition; (iii) electron transport measurements at helium temperatures - to determinate electron concentration and mobility.

The very first photoluminescence and transport results show that 2DEG is in fact formed inside the QWs that were modulation doped with indium. The electron concentrations of up to $7.6 \cdot 10^{11}$ cm^{-2} and mobility reaching 110000 cm^2/Vs have been obtained. This value of mobility is lower than that of the structures doped with Iodine grown in the same period of time, however there is a hope that after further optimization of Indium doping the mobility will improve.

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[1] A. Kazakov, G. Simion, Y. Lyanda-Geller, V. Kolkovsky, Z. Adamus, G. Karczewski, T. Wojtowicz, and L. P. Rokhinson, Phys. Rev. Lett. 119, 4, (2017).