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Electrical and optical properties of arsenic - implanted $Cd_xHg_{1-x}Te$ MBE films

Ihor Izhnin[1,2], Alexander Voitsekhovskii[2], Alexander Korotaev[2], Olena Fitsych[1], Olexander Bonchyk[3], Hregory Savytskyy[3], Karim Mynbaev[4], Vasiliy Varavin[5], Sergey Dvoretsky[5], Nikolay Mikhailov[5], Maxim Yakushev[5], Rafal Jakiela[6] and Neonila Levintant-Zayonts[7]

[1] *Scientific Research Company "Carat", St. Stryyska 202, 79031 Lviv, Ukraine*
[2] *National Research Tomsk State University, St. Lenina 36, 634050 Tomsk, Russia*
[3] *Ya.S. Pidstryhach Institute for Applied Problems of Mechanics and Mathematics NASU, St. Naukova 3b, 79060 Lviv, Ukraine*
[4] *Ioffe Institute, St. Polytechnicheskaya 26, 194021 St. Petersburg, Russia*
[5] *A.V. Rzhanov Institute of Semiconductor Physics RAS, Av. Ac. Lavrentieva 13, 630090 Novosibirsk, Russia*
[6] *Institute of Physics, PAS, Al. Lotnikow 32/46, 02-668 Warsaw, Poland*
[7] *Institute of Fundamental Technological Research PAS, St. Pawinskiego 5B, 02-106 Warsaw, Poland*

The aim of this work was to study defect structure of arsenic-implanted $Cd_xHg_{1-x}Te$ films with the use of optical reflectance and electrical measurements.

We have studied two types of $Cd_xHg_{1-x}Te$ (MCT) films grown with molecular-beam epitaxy (MBE) on Si or GaAs (013) substrates. The 1st type was represented by *p*-type films implanted with As^+ ions with the energy E=190 keV and doses 10^{13}, 10^{14} or 10^{15} cm^{-2} without post-implantation annealing, and the 2nd type, by *n*-type films implanted with As^+ or As^{++} ions with E=190 and E=350 keV, respectively, and a 10^{14} cm^{-2} dose with activation annealing in saturated Hg vapors.

The results of the optical studies showed that increasing the dose the 'sharpness' of the reflectance peaks E_1 and $E_1+\Delta_1$, decreases which reflected the increase of the scale of structural damage, but activation annealing restored structural perfection.

The electrical studies showed that in the 1st type of films, implantation resulted in the formation of n^+-n structure with the concentration of low-mobility electrons defined by radiation-induced donor defects, whose profile extended much deeper than that of the implanted arsenic. Formation of an *n*-layer with high-mobility electrons was discovered, this layer formed due to annihilation of interstitial mercury with mercury vacancies. For the 2nd type of films, we observed formation of p^+-n structure, and the concentration of heavy holes was very close to that of the implanted arsenic. This showed that the annealing eliminated radiation-induced donor defects and activated nearly 100% of the arsenic atoms.