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Highlights

- The influences of various annealings on lattice defects are established.
- Annealing effects on electrical properties of the films $Hg_{0.7}Cd_{0.3}Te$ are presented.
- Analysis of the experimental data shows the presence of two types of electrons.
- Dependence of minority carrier lifetime on the doping level of In are presented.

Abstract

The electrical properties of undoped and doped with indium $Hg_{1-x}Cd_xTe$ ($x \approx 0.3$) films grown by the MBE method on Si (013) were investigated. In as-grown films, staking faults and trending dislocations with densities of ~10^6 cm^{-2} and ~10^7 cm^{-2}, respectively, are observed. Annealing films under conditions causing the formation of mercury vacancies leads to drastic decrease of the staking faults (<10^4 cm^{-2}). Filling vacancies leads to a decrease in the contribution of Shockley-Read recombination and to an increase in the lifetime. The dominant generation-recombination level in the as-grown $Hg_{1-x}Cd_xTe$/Si(013) is the level associated with the vacancies. The magnetic field dependences of the Hall effect in the magnetic field range of 0.05–1.0 T at 77 K were explained by the fact that, in the films, there are two types of electrons with high and low mobilities.

Keywords: HgCdTe (MCT), Molecular-beam epitaxy (MBE), Heterostructure, Lattice defect, Minority carrier lifetime, Magnetic field dependences.

1. INTRODUCTION

The II–VI semiconductor $Hg_{1-x}Cd_xTe$ (MCT) is a base material for infrared focal-plane arrays (IR FPAs). Today general goal in IR FPAs manufacturing is the decrease of cost, size and electrical consumption, while maintaining high parameters. For solving these problems, there are two main methods. First, it is a transition to large-diameter heteroepitaxial structures grown on silicon substrates [1]. Such structures allow minimizing the cost of the material, which is going to manufacture one IR FPA, and automatically solve the problem of thermomechanical strength of the IR FPA at multiple cooling cycles from room to operating temperature. The second way is to increase the operating temperature of the IR photodetectors [2], which is achieved by reducing