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Luminescence studies of HgCdTe–and InAsSb–based quantum well structures

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HgCdTe and InAsSb are important materials for fabricating photo– and optoelectronic devices operating in the infrared part of the spectrum. Representing II–VI and III–V semiconductor materials, respectively, they differ in crystalline structure, chemical bonding, etc., yet have similar electronic structure. Effects of non-parabolicity of energy bands and mixing between the states of electrons and three types of holes (heavy, light, and spin–splitted ones) make these materials quite special, which shows in their optical properties.

In this work, we report on photoluminescence studies of single quantum-well (SQW) HgCdTe–based structures (heterostructure (HS) of type I) and electroluminescence studies of multiple quantum-well (MQW) InAsSb–based structures (HS of type II). SQW $Hg_{1-x}Cd_xTe$ samples were grown at the Institute of Semiconductor Physics (Novosibirsk, Russia) by molecular beam epitaxy on GaAs substrates with ZnTe/CdTe buffer layers and had composition in the well x=0.24 and in the barriers, x=0.80. The QW width was 12 nm. InAsSb–based structures were grown at Microsensor Technology, LLC (Saint-Petersburg, Russia) on InAs substrates and represented MQW $16\times InAs_{0.94}Sb_{0.06}/InAs_{0.78}Sb_{0.07}P_{0.15}$ (6 nm/11 nm) structures with wide-bandgap InAsSbP layer grown on top of the samples. The growth was performed with metal-organic chemical vapor deposition.

The common feature of luminescence spectra of the structures was the presence of peaks with energy much larger than that of calculated optical transitions between the first quantization levels for electrons and holes. In the paper, observation of optical transitions between the quantization levels of electrons and heavy and light hole levels will be discussed in relation to the specifics of the electronic structure of HS of types I and II of the materials under consideration.