Higher-Order Optical Transitions in InAs/GaSb Superlattices

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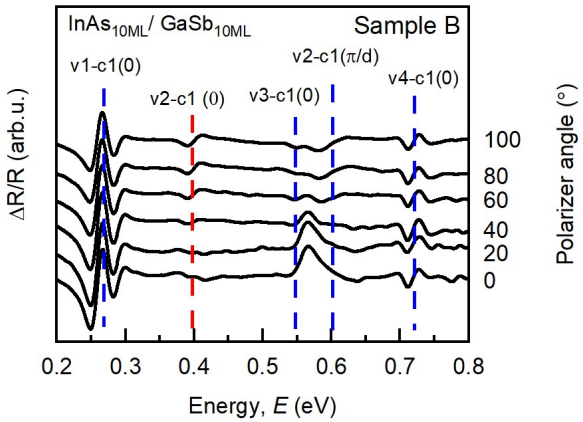
Mid- and far-infrared light is widely utilized in air composition analysis, since absorption lines of many gaseous products are localized in these spectral ranges. Commonly used devices for that purpose are small spectrometers with an emitter and a detector, adjusted for particular spectral range, matching the absorption lines of analyzed gases. Considering the detecting part of the spectrometer, one of the biggest competitors to popular HgCdTe-bulk detectors are type-II superlattice (T2SL)-based devices. Despite their successful development in recent years, there is still room for improvement in terms of i.e. sensitivity, current characteristics and working temperature. [1]

We present an optical spectroscopy analysis of the molecular beam epitaxy (MBE)-grown InAs/GaSb quantum systems to study the higher-order optical transitions in InAs/GaSb superlattices (SLs). In particular, we have investigated two T2SL structures with different layer widths - $InAs_{8ML}/GaSb_{8ML}$ and $InAs_{10ML}/GaSb_{10ML}$.

To experimentally determine the spectral distribution of the higher-order transitions originating at two points of superlattice wavevector - $k_z = 0$ and $k_z = \pi/d$ - the Fourier-transformed photoluminescence (FTPL) and Fourier-transformed photo-modulated reflectance (FTPR) measurements were used. Measurements were undertaken versus temperature and incident polarization of the probing beam. Complementary theoretical calculations based on the eight $k \cdot p$ formalism were also performed to identify the electron, heavy and light hole energy band ladder. [2]



[1] A. Rogalski, P. Martyniuk, M. Kopytko, P. Madejczyk, S. Krishna, *Sensors*, **20(24)**, 7047 (2020).
[2] M. Rygała, K. Ryczko, T. Smołka, D. Kujawa, P. Martyniuk, T.J. Ronningen, S. Krishna, *Phys. Rev. B*, **104**(8) (2021)