Optimal 1D Microcavity Structure for THz Emission from Optically Pumped GaP Layer: Electromagnetic Analysis by the Method of Single Expression

H.V. Baghdasaryan[1], T.M. Knyazyan[1], T.T. Hovhannisyan[1], A.A Hakhoumian[2] and M. Marciniak[3,4]

[1]National Polytechnic University of Armenia, [2]Institute of Radiophysics & Electronics NAS, Armenia,

[3]National Institute of Telecommunications, Poland, [4]Kielce University of Technology, Poland

E-mail: M.Marciniak@itl.waw.pl

The terahertz (THz) band of electromagnetic (EM) waves is under high interest during last decades since considerable number of new phenomena in EM wave - matter interaction in this range has been found [1]. There exist different ways of exciting THz waves [1,2]. Our analysis considers THz wave emission technique using non-linear optical effect in semiconductors known as THz wave rectification [2].

It is known that 1D microcavity strongly influences THz emission from semiconductor layer of GaP at optical pump [3]. Thus, the comprehensive analysis for obtaining optimal microcavity structure is pertinent. In the present work Fabry – Perot type micro-resonators with DBR mirrors of SiO_2/Air bilayers are analysed numerically via the method of single expression (MSE) [4,5].

In our analysis it is indicated, that emission intensity from "DBR – GaP layer – DBR" structure strongly depends not only on the number of layers in DBRs but also on the outermost layers' permittivity. For efficient emission of THz waves from a GaP layer adjacent to semiconductor DBRs' layers should be of low dielectric permittivity what was indicated also in [3]. Further enhancement of THz emission from this type of multilayer structure is possible by an increase of micro-resonator's Q – factor, which requires an increase of the number of bilayers in DBRs.

Electromagnetic modelling by the MSE has permitted us to obtain distributions of electric and magnetic fields and Poynting vector within the considered structures that gives the clear explanation of physics of efficient THz emission from optimal 1D microcavity. Resonant emission takes place at frequencies coinciding with the resonant transparency of microcavity with GaP as a spacer.

References:

[1] M. Perenzoni, D. J. Paul: Physics and Applications of Terahertz Radiation, : Springer (2013).

[2] K.Sakai, ed., Terahertz Optoelectronics, : Springer (2005).

[3] H. Shirai, K. Ishii, H. Miyagawa, Sh. Koshiba, S. Nakanishi, N. Tsurumachi: Efficient terahertz emission, detection, and ultrafast switching using one-dimensional photonic crystal microcavity, *J. Opt. Soc. Am. B*, **31** 1393 (2014).

[4] H.V. Baghdasaryan, T.M. Knyazyan. Problem of plane EM wave self-action in multilayer structure: An exact solution, *Optical and Quantum Electronics*, **31** 1059 (1999).

[5] H.V. Baghdasaryan, T.M. Knyazyan, T.H. Baghdasaryan, B. Witzigmann, and F. Roemer, Absorption loss influence on optical characteristics of multilayer distributed Bragg reflector: wavelength-scale analysis by the method of single expression, *Opto−Electronics Review*, **18** 438 (2010).

Authors acknowledge the support from MPNS COST ACTION MP1204 - TERA-MIR