

## LED and Photodiode Heterostructures for Portable Optical Sensors

Nikolay Stoyanov, Sergey Kizhaev, Andrey Petukhov, Karina Kalinina, Hafiz Salikhov

Microsensor Technology, LLC., Russia

e-mail: k.kalinina@lmsnt.com

The increasing need to enhance and improve the control of chemical agents presence in gas, liquid and solid substances for various application areas including ecological and safety monitoring has encouraged the development of advanced high technological sensors. Qualitative technological break-through in growing of narrow band-gap heterostructures based on GaSb-InAs solid solutions has enabled creation of the new components – middle infrared LEDs and photodiodes (PDs) and development of portable non-dispersive infrared (NDIR) sensors on their basis.

GaInAsSb based solid solutions allow obtaining direct bandgap semiconductor materials with staggered heterojunctions as well as type-II heterojunctions depending on the solution composition. GaInAsSb/AlGaAsSb heterostructures lattice matched to GaSb substrate allowed developing LEDs and PDs for 1.6-2.4  $\mu\text{m}$  spectral range, InAsSb/InAsSbP lattice matched to InAs substrate – for 2.8-5.0  $\mu\text{m}$  spectral range [1]. Test sample of a compact optical cell for methane detection with super low power consumption has been recently reported [2]. An LED was driven by packets of very short current pulses, so that the LED electrical power consumption was only 0.05 mW.

This work reports on the further improvement of the methane sensor module. Increasing of the LED and PD external quantum efficiency by applying special glass covering has enabled detection down to 100 ppm methane concentration. Electronic circuit was improved by including the ability for temperature compensation judging by the LED p-n junction temperature. This sensor module demonstrates the main benefits of the diode technology for sensing applications such as: high selectivity, low power consumption, fast response and long life time. It becomes possible to arrange wireless sensor networks with battery powered autonomously operated detecting units for constant environment monitoring.

### References

1. N. Stoyanov, Kh. Salikhov, K. Kalinina, B. Zhurtanov, S. Kizhaev, Proceedings of SPIE, **8257**, 82571E-6 (2012)
2. N.D. Stoyanov, Kh.M. Salikhov, K.V. Kalinina, S.S. Kizhaev, A.V. Chernyaev, Proceedings of SPIE, **8982**, 89821A (2014)