WIDE-RANGE DIODE TEMPERATURE SENSOR BASED ON DH InGaN/AlGaN/GaN

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Diode temperature sensors (DTS) have been being successfully applied for a long time in various fields of industry, environmental control equipment and scientific researches. The DTS specifically intended for space applications should operate in the temperature range from almost cryogenic ($\leq$ 20 K) up to above room temperatures, should be stable under ionizing radiation and magnetic field exposure, should have high thermal sensitivity and linear thermometric characteristics, should have low (micro- and nanowatt) power consumption as well as high level of noise immunity. It is known [1, 2] that the DTS based on wide bandgap III-V semiconductors successfully meet the above requirements.

We have developed the DTS with sensitive element based on double heterostructure (DH) chip of InGaN/AlGaN/GaN fabricated by Nichia Chemical Industries [3] using original chip processing technology and packaging by composite compounds. After the characterization and testing procedures the following basic parameters of the DTS were established:

- operation temperature range, K: 15-450;
- excitation (drive) current, A: 10^{-10}–10^{-6};
- sensitivity, mV/K: 6.5 (current-independent);
- the range of forward voltage change, V: 0.4–2.5;
- long-term stability, K: $\pm$ 0.03;
- interchangeability, K: $\pm$ 0.5;
- thermal inertia index, s: $\leq$ 0.05.

In contrast to known analogs the DTS developed are distinguished by high values of their thermal sensitivity (for example, for commercial Si DTS the value does not exceed 2.5 mV/K) and its stability in the whole operation current range. In particular, this allows to improve and to simplify the matching of DTS with long transmission lines. The latter is very important for numerous applications in case of temperature monitoring of remote objects. It is noted that the DTS developed has much lower power consumption rate than well-known Si- or AlGaAs-based DTS. This makes the DTS more preferable for applications in automatic satellites and space stations. Results of the investigations on the correlation between the DTS parameters and their fabrication technology conditions are also presented in the work.

[1] Y. B. Acharya and A. K. Agarwal. Meas. Sci. Technol. 7, 151 (1996).
[2] A.M. Fonkich, D.P. Kopko, V.A. Krasnov, S.V. Shutov, M.M. Shwarts, Yu.M. Shwarts, N.I. Sypko, S.Yu. Yerochin, e-print arXiv:cond-mat 0806.4138, http://arxiv.org/abs/0806.4138v1
[3] S. Nakamura. J. Vac. Sci. Technol. A.13, 705 (1995)

Keywords:
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