P17

Comparison of AlGaN/GaN HEMT and silicon nMOS terahertz detectors with the same length of the gate.

Juozas Vyšniauskas and Alvydas Lisauskas

Institute of Applied Electrodynamics and Telecommunications, Vilnius University, Saulėtekio av. 3, LT-10257 Vilnius, Lithuania.

Email: juozas.vysniauskas@ff.vu.lt.

A comparison of AlGaN/GaN HEMT and silicon nMOS terahertz detectors was made using two-dimensional Hydrodynamic (HD) and Drift-Diffusion (DD) models implemented in the Synopsys TCAD Sentaurus program package. The HEMT structure described in [1] with the exception of the Gate (L_G) and the Ungated (L_{UG}) regions length. We used L_G = L_{UG} = 100 nm and AlGaN thickness equal to 15 nm. The structure of nMOS coincides with the standard 130 nm CMOS technology with L_G = 100 nm and SiO_2 thickness of 2.5 nm. HD and DD models were compared as well. A simpler DD model requires less computer time and can be used for the calculation of current responsivity and Noise Equivalent Power (NEP) at the frequencies lower than 0.2–0.3 THz. At higher frequencies, such as 1.0 THz (Fig. 1 and Fig. 2), the energy balance equation must be included in the model (HD).

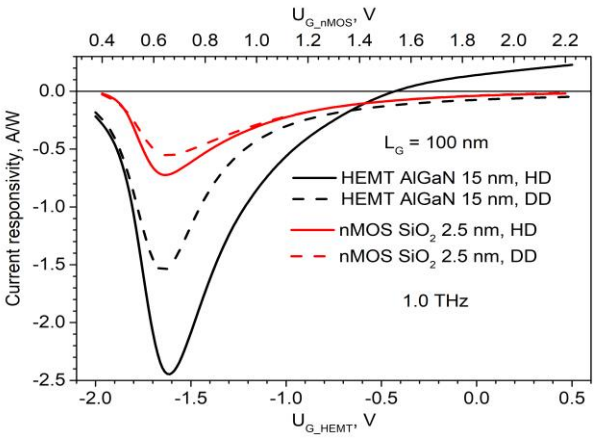

Fig. 1 The dependence of current responsivity on gate voltage U_G of HEMT and nMOS terahertz detectors with gate length L_G = 100 nm at 1.0 THz.

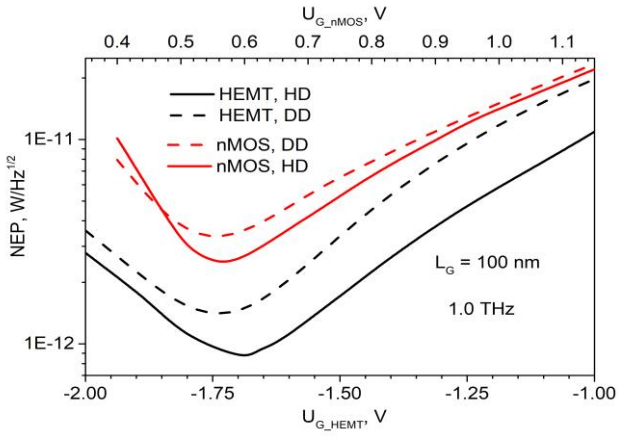

Fig. 2 The dependence of Noise Equivalent Power on gate voltage U_G of HEMT and nMOS terahertz detectors with gate length L_G = 100 nm at 1.0 THz.

The maximum current responsivity is about 3.5 times higher in HEMT than in nMOS, despite the existence of two passive ungated regions in HEMT. The electron mobility in the 2D channel in undoped HEMT is much higher than in highly doped ($2.5 \cdot 10^{18}$ cm^{-3}) nMOS. The minimum NEP is about 3 times lower in HEMT than in nMOS. Thus, HEMT is more appropriate for the detection of weak terahertz signals.

REFERENCES

[1] J.Vyšniauskas, A.Lisauskas, M.Bauer, D.Čibiraitė, J.Matukas and H.G.Roskos; *IOP Conf. Series: Journal of Physics: Conf. Series* **906** (2017) 012023 pp.1-4.