Fast response HOT (111) HgCdTe MWIR detectors

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Higher operation temperature (HOT) condition of the middle-wave (4.1µm) photodetectors is one of the most important research areas in infrared technology. The development of the new detector architectures ($N^+pP^+n^{+)}$ has been driven by applications requiring fast response operation. This requirement stays in contradiction with reaching high detectivity in terms of detector optimization.

Typically, the response time is determined by drift and diffusion of photogenerated charge carriers to the contact region for higher voltage condition, while for weak reverse bias recombination decay plays dominant role. Assuming that, the depletion region occupies only small part of active region and absorption occurs in neutral region of absorber, the response time is conditioned by recombination decay and diffusion of photogenerated carriers to the contacts. For absorber thickness comparable or larger than diffusion length, the response time is limited by the recombination time.

The device presented in this work was fabricated in the joint laboratory run by VIGO Systems S.A. and Military University of Technology (MUT). The (111) HgCdTe layers were grown on 2"in., epiready, semi-insulating (100) GaAs substrates in a horizontal MOCVD AIX 200 reactor. The time response was measured with optical parametric oscillator (OPO) producing 25 ps pulses of tunable wavelengths in range of 1.55–16µm.

The time response of the MWIR HgCdTe detector with 50% cut-off wavelength of $\lambda c \approx 4{,}1\mu m$ at T = 230 K was estimated at the level of $\tau < 1$ ns for V >500 mV.