Mobility and noise in n-type semi-metallic Hg$_{1-x}$Cd$_x$Te quantum well for THz detection applications
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**Structures:** Hg$_{0.3}$Cd$_{0.7}$Te / Hg$_{0.4}$Cd$_{0.6}$Te / Hg$_{0.5}$Cd$_{0.5}$Te quantum wells with semi-metal band scheme and without bands overlap at 77 K.

**Why** them are perspective for THz detection? High intrinsic concentrations, high mobilities and low resistances at 77 K.

**Thus** complex numerical modeling of their transport properties and noises is important for further construction of THz receivers.

**We considered:** inelastic scattering, dispersion law, non-parabolicity, bands mixing, system degeneracy, graphene-like screening.

**Methods used:** 8x8 k.p method, direct iterative solution of Boltzmann transport equation.

**Energy spectra** of QW with $x=0.06$ on well width, $L$. Increase of $L$ leads to transition from semi-conducting to semi-metallic state.

**Role of different scattering mechanisms.** Considered mechanisms: holes, charged impurities (CI), interface, optical (LO) and acoustic phonons. The QW width is 20 nm. $N_v=10^{15}$ cm$^{-3}$. $T=77K$. LO - scattering is suppressed due to dynamical screening strengthening.

**Calculated electron mobility.** Well width = 20 nm. Charged impurities concentration in QW is $10^{15}$ cm$^{-3}$.

**Change** of the electron concentration could be achieved by delta-doping of barriers or by applying the top-gate bias voltage.

**High** electron mobility can be obtained at high electron concentration in the QW, which decreases holes concentration and enhances 2DEG screening.

**Calculated thermal noise.** Channel thickness = 20 nm.

To obtain the optimal operation characteristics of a semimetal MCT QW channel, a high electron concentration in the QW should be provided, channel chemical composition $x$ should be close to the band structure inversion point, and charged impurities concentration should not exceed $10^{15}$ cm$^{-3}$.

**Conclusions.** We have found, that:

- In semi-metal HgCdTe QW channel of HEB or HEMT the channel resistance varies by more than two orders of magnitude depending on the electron concentration. Such a dependence could provide high volt-watt sensitivity of the hot-electron bolometer, as small variations in the gate voltage should result in strong changes of the bolometer resistance. A high dynamical tunability makes up another benefit of the considered system for the THz detection.
- To obtain the optimal operation characteristics of a semimetal MCT QW channel for THz detectors, one should provide a high electron concentration in the QW, and adjust the channel chemical composition $x$ to be close to the band structure inversion point (just below the inversion point, to avoid activating an additional mechanism of scattering on the effective mass fluctuations).
- Semimetal HgCdTe QWs used as a channel for THz hot-electron bolometer at the liquid nitrogen temperature is able to provide high operation speed combined with high sensitivity and low noise.
- HgCdTe THz HEB advantages compared to the graphene HEB: higher mobility, lower noise, higher operational speed, more efficient coupling to planar antennas in THz range detector applications.