Low-frequency noise and sub-THz detection in Graphene/AlGaN/GaN heterostructures

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Combination of the graphene (GR) on the top of AlGaN/GaN field-effect transistor transistors (FETs) a unique system with closely spaced two high conductivity 2D layers. This kind of system is a promising platform to study the two-stream instability in the terahertz frequency band in the system of massless electrons in graphene and 2D electrons in GaN. The possibility of plasmon resonance in graphene [1] and the 2DEG channel creates a promising platform for the combination of these materials in order to create perspective compact THz detectors, emitters, and amplifiers. In this work, we studied the quality of the created devices and demonstrates the possibility of sub-THz detection GaN/AlGaN fin-shaped FETs with GR gate (shown in Fig.1a). Investigated structures were fabricated using the technology described in detail in Ref. [2]. Barrier height and ideality factor of GR/AlGaN Schottky barrier found from current-voltage characteristics were ϕ_b = (1.0 - 1.26) eV and (1.7 - 2.5), respectively.

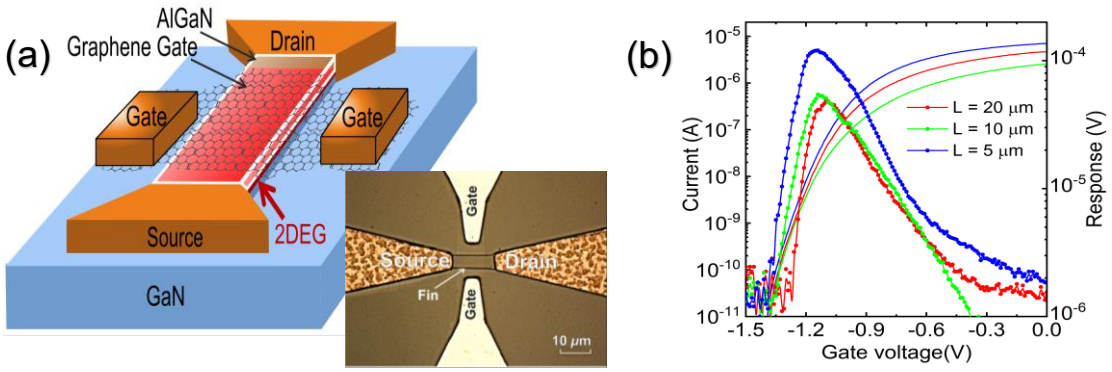

Fig. 1. (a) – Schematic view optical microscope images of the fin-shaper GaN/AlGaN FET with Graphene gate; (b) – DC characteristics and response of Graphene/GaN/AlGaN FinFETs with different gate lengths L = 5, 10, 20 μm and constant channel width W = 4 μm at frequency f =120 GHz at room temperature.

DC characteristics and response at the frequency *f* = 120 GHz of GaN/AlGaN FinFETs with GR gate are shown in Fig. 1b. The devices were characterized by a 8 order of magnitude on/off ratio and subthreshold slope ~ 1.3. Measurements of the low frequency noise allowed us to extract the effective trap density responsible for noise, which was similar to Ni/Au gate FinFETs. Good noise properties are important for the operation of low signal high frequency amplifiers, mixers, and detectors. The response peaks are located near the threshold voltage of investigated FinFETs. The results obtained in this work are important for THz electronics and plasmonics.

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