P05

Hole transport in graphene field-effect transistor structures on SiO_2

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Since the discovery of graphene in 2004, there have been intensive studies in two-dimensional materials research [1,2]. Various properties, including optical, magnetic and electrical were explored. The goal of this work is to investigate carrier transport in back-gated graphene field-effect transistor structures. The samples were prepared using CVD monolayer graphene on Cu foil. The graphene film was then transferred to 300 nm SiO_2/p-Si wafers using the wet transfer method [3]. Graphene channels were formed as transmision line method (TLM) patterns with various lengths (L = 5, 10, 15, 20, 30 μm) and a width w = 75 μm. Ti/Au (3/45 μm) contact metals were deposited by an e-beam evaporator. The graphene DC current transfer and output characteristics showed the presence of p-type type graphene channel. Graphene field-effect mobility was estimated to be 1030 cm^2/Vs and hole density was 2-2.2x10^{12} cm^{-2}.

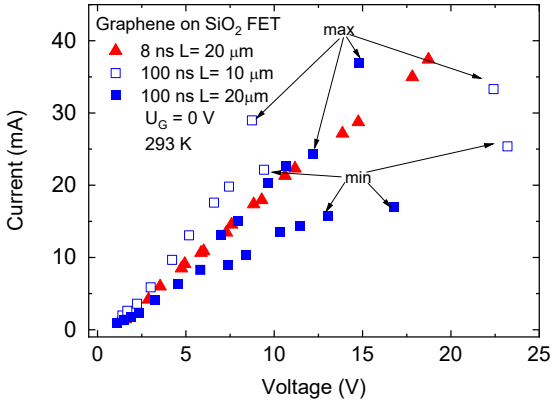

Fig. 1. Pulsed current-voltage characteristics in graphene FETs at U_G = 0 V. Pulse duration: 100ns (squares), 8 ns (triangles). Current curves with maximum (max) and minimum (min) values. Channel length 10 μm (empty squares), 20 μm (triangles, full squares).

Current-voltage characteristics were measured both in DC and pulsed (8 ns, 100 ns) regimes. Pulsed current values up to 40 mA and voltages up to 23 V were reached at a gate voltage U_G = 0 V (Fig. 1). Current oscillations were observed within the certain amplitude interval what corresponds to the max and min current curves [4]. The hole drift velocity was estimated from non-oscillating measured pulsed current density and constant carrier density. The highest drift velocity of ~1.5x10^7 cm/s was estimated at ~18 kV/cm electric field. This value of the hole drift velocity is in agreement with that for graphene grown on SiC and dry transferred on SiO_2 [5]. It can be associated with the influence of non-equilibrium (hot) optical phonons launched by hot-carriers present at moderate-high electric field.

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