Radio-Frequency Graphene Field-Effect Transistors Based on Millimeter-Scale Graphene Domain

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Abstract
Graphene is a promising candidate in radio-frequency (RF) applications due to its ultrahigh carrier mobility [1], and tolerance to large current density [2]. Several advanced techniques have been exploited in fabricating graphene field-effect transistor (FET) involving reduction of access resistance, gate capacitance, output conductance [3], contact resistance [4] and enhancement of insulating layer quality [5], seeking for high cut-off frequency (f_T) and maximum oscillation frequency (f_{max}). Here, we present high-performance top-gated RF FETs using a millimeter-scale graphene domain with a conventional fabrication process. A maximum f_T of 178 GHz and a peak f_{max} of 35 GHz are achieved in the graphene-domain-based FET with a gate length of 50 nm and 150 nm, respectively. This work shows that the millimeter-scale single graphene domain has great potential in RF devices and circuits.

References

[1] K. I. Bolotin et al., Solid State Commun., 146 (2008) 351
[2] R. Murali et al., Appl. Phys. Lett., 94 (2009) 243114
[3] R. Cheng et al., Proc. Nation Acad. Sci., 109 (2012) 11588
[4] J. A. Robinson et al., Appl. Phys. Lett., 98 (2011) 053103
[5] Q. Ye et al., IEEE ICSICT, Oct. 28-31 (2014) 1

Figures

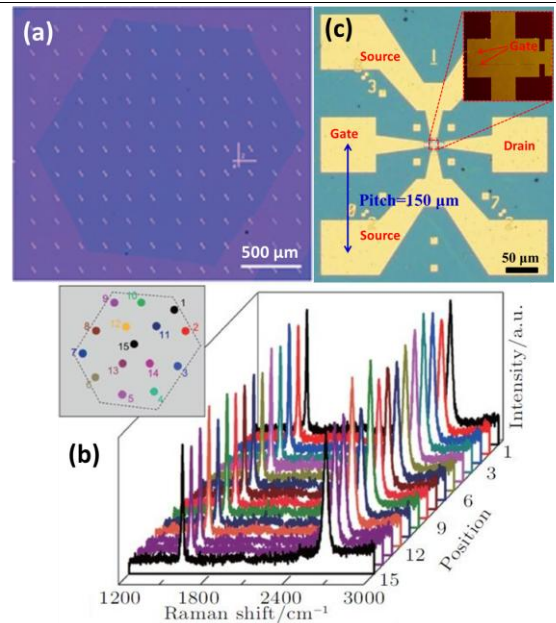

Figure 1: (a) Optical image of an individual graphene domain; (b) Optical image of a GFET with an AFM zoom-in picture at active region; (c) Raman spectra of the grapheme domain.

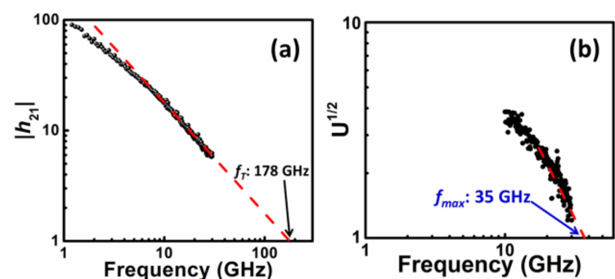

Figure 2: Plots of de-embedded current gain of a 50-nm-gate GFET (a) and Mason unilateral power gain of a 150-nm-gate GFET (b).

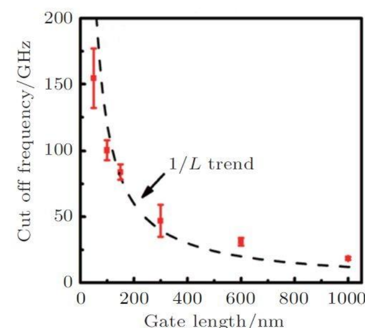

Figure 3: Variations of peak f_T with gate length (L) obtained from 30 devices. The dashed line indicates their 1/L dependence