Supporting Information

Top-gated CVD Graphene Transistors with Current Saturation

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1. CVD graphene growth and transfer method

The growth of graphene is based on the ambient pressure CVD method reported previously by Bhaviripudi *et al.*.[1] Generally, the graphene was grown on Cu foil at 1050 °C with methane as the precursor. At first, Cu foils (25 μm thick) is placed into 1 inch quartz tube without pretreatment. The tube is pumped and purged with H_2/Ar (5:95) for three times in order to eliminate oxygen. The furnace is then allowed to heat up to 1080 °C with H_2/Ar flow (25 sccm/475 sccm) to anneal the Cu foil for 90 minutes. After annealing, the temperature is dropped to 1050 °C in 10 minutes. The graphene growth starts with the flow of methane (500 ppm methane in Ar, 35 sccm) with reduction of the H_2/Ar flow to 25 sccm/440 sccm. The growth process lasts for 3 hours and stops by fast pulling the tube out of the furnace.

After growth, the graphene is transferred onto silicon/silicon oxide substrate for characterization and device fabrication. Initially, the graphene is grown on both side of the copper

foil. To transfer the graphene, we first spin coat a layer of PMMA (495 PMMA C2, MicroChem) film onto one side of the graphene/Cu foil and clean the other side with O_2 plasma. The copper is then etched away using copper etchant (Transene, CE-100) by floating the foil on the surface of the etchant bath. The PMMA/graphene film is washed with HCl/H_2O (1:10) and DI water for several times, and transferred onto silicon/silicon oxide substrate. After drying the substrate in vacuum, a small droplet of PMMA is dropped on the substrate to partially dissolve the dried PMMA, and dried in atmosphere. This process is reported to release stress of the graphene/substrate contact.[2] Finally, the PMMA is dissolved in acetone for 2 hours. The graphene quality is characterized with Raman spectroscopy, showing single layer nature and good film quality (Figure S1).

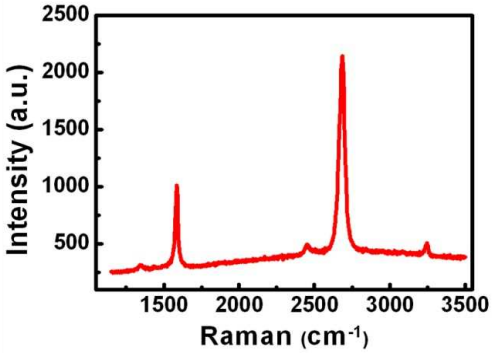

Figure S1. Typical Raman spectroscopy of CVD grown graphene.

2. Characterization of evaporated HfO_2:

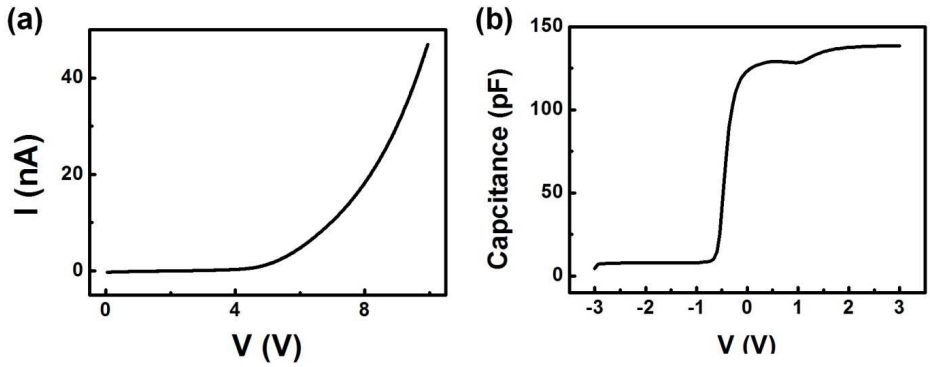

Figure S2. (**a**) Leakage current and (**b**) capacitance measurement of a metal-insulator-semiconductor device with 50 nm HfO_2 on n-type Si substrate. The device area is 200 μm×200 μm.

3. Conductance of 5.6μm channel device.

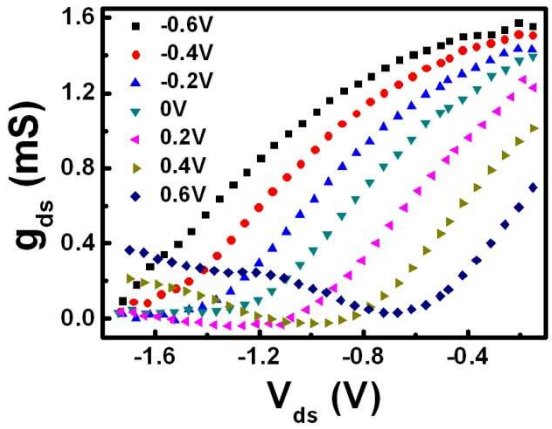

Figure S3. Drain conductance as a function of V_{ds} at different gate voltage showing full current saturation in the device with gate length of 5.6 μm.

Reference:

1. Bhaviripudi, S.; Jia, X. T.; Dresselhaus, M. S., and Kong, J. *Nano Lett.* **2010**, 10, 4128-4133.
2. Li, X. S. *et al. Nano Lett.* **2009**, 9, 4359-4363.