Back-gated Microwave Field-Effect Transistors Based on Transferred CVD-Grown Graphene

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Abstract  Graphene based transistors have drawn growing interest from both industries and laboratories [1-3]. In this work, we present both fabrication process and characterization of graphene field-effect transistors. Large scale monolayer graphene was grown by chemical vapor deposition (CVD) on Cu foils and transferred over pre-patterned back-gated devices on Si/SiO₂ substrate. Scanning electron microscopy, Raman spectroscopy and Hall effect measurement were used for characterizing graphene quality before and after the transfer. It was found that monolayer graphene with a low defect density and hole mobility up to 3180 cm²/Vs at n=1.3·10¹² cm⁻², could be obtained. For device characterization, we report an intrinsic current gain cut-off frequency (f₁) of 13.5 GHz and maximum oscillation frequency of 8 GHz, deduced from the S-parameters measurements. This study demonstrate the potential of CVD-grown graphene for high speed electronics in combination with a technological process compatible with arbitrary substrates [4,5].

References

Figures

Fig 1. Schematic of (a) the device fabrication process and (b) the graphene transfer process
Fig 2. (a) Raman spectra of graphene and SEM images of (b) overview of the final device and (c) active part and (d) enlarged channel part, where has the gate length of 300nm.

Fig 3. Transfer characteristics of the device, Dirac Point is at $V_{gs}=0.8$V, the maximum $G_m$ is -150μS/μm.

Fig 4. Drain current $I_{ds}$ versus drain voltage $V_{ds}$ at different gate voltage.

Fig 5. RF characteristics, as measured (DUT) and after de-embedding (Intrinsic) of a device with gate length $L_g=200$nm at $V_{gs}=2$V. We found an intrinsic cut-off frequency ($f_t$) of 13.5 GHz and a maximum oscillation frequency of 8 GHz.