Highly Efficient CVD Growth of Functionalized Bilayer Graphene by Oxidative Dehydrogenation Chemistry

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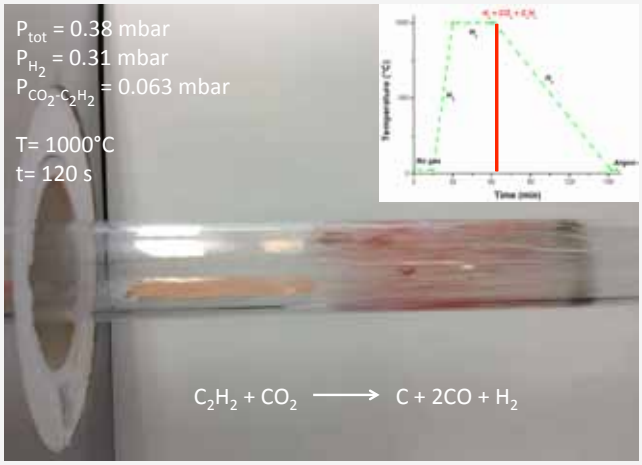
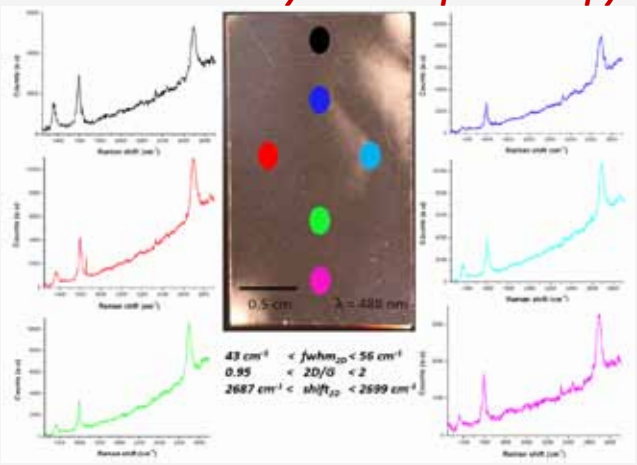
Introduction

Several Chemical Vapor Deposition recipes have been developed so far for the synthesis of bilayer graphene. However high temperature is required or they exhibit a low reaction yield. Here we report a new route of bilayer graphene synthesis by CVD using acetylene as carbon precursor and oxidative dehydrogenation chemistry. Using this chemistry, CNT's were successfully grown on oxides at low temperature (<750°C)[1]. Moreover our graphene could contain reactive oxygen functional groups.

Growth Conditions

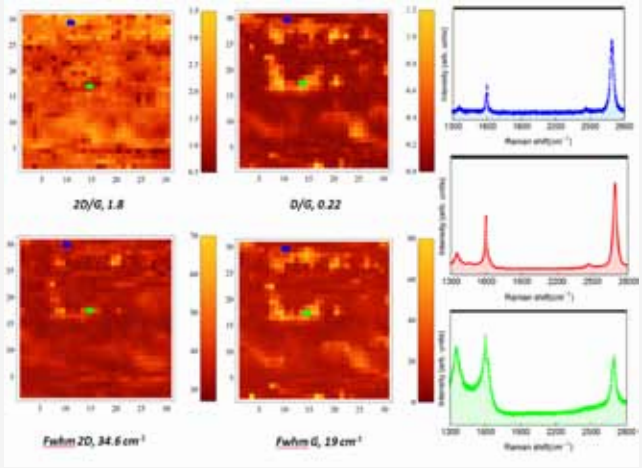


Characterization by Raman Spectroscopy

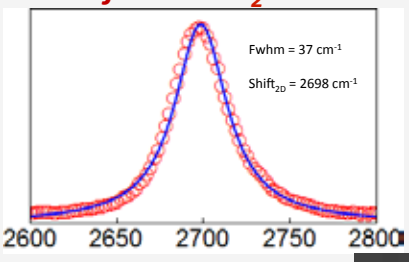


Homogeneous bilayer graphene is grown on both side of the copper foil

Characterization after transfer on SiO_2



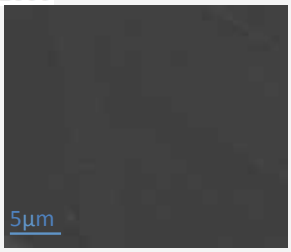
Raman maps after wet chemical transfer on SiO_2 using PMMA



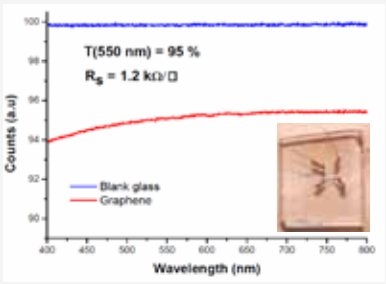
2D peak is fitted with **one Lorentzian peak**

Misoriented bilayer graphene

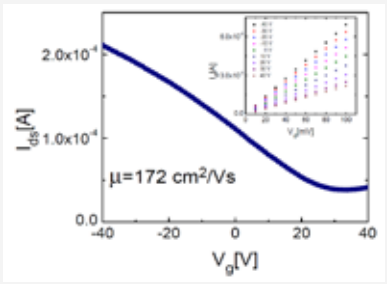
Scanning Electron Microscopy
Polycristalline graphene
Grain size: 10-15 µm



Optical and electrical properties



Typical transmittance [2] and sheet resistance [3] of millimeter scale bilayer graphene grown by CVD.



Back gating configuration, field effect mobility ranges from 100 to 600 $cm^2/V.s$. Transistor dimension: W = 200 µm et L = 250 µm.

Conclusion

We have successfully adapted the ODH chemistry for the growth of bilayer functionalized graphene. The yield of reaction is 10^4 higher than to the reference synthesis using methane. The relative low mobility obtained can be attributed to the presence of functional groups on the graphene surface. Future development will aim at the reduction of the growth temperature as well as at the direct growth of graphene on oxides.

References

[1] Magrez et al, ACS Nano 2010, 7, 3702-3708
[2] Nair et al, Science 2008, 320, 1308
[3] Bae et al, Nat. Nano. 2010, 5, 574-578