Lattice Matched Epitaxial Graphene Grown Using High Temperature Molecular Beam Epitaxy

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Aligned graphene grown at high temperatures on hexagonal boron nitride (hBN) using molecular beam epitaxy (MBE) is found to exhibit large-period hexagonal moiré patterns when imaged using atomic force microscopy (AFM) [1]. Raman spectra of the strained graphene reveal red-shifting and splitting due to strain variations across the moiré unit cell. The red-shifting of the 2D peaks increases with increasing moiré periodicity, indicative of greater strain in the graphene monolayer [2]. At the highest growth temperature (~1710°C) we observe a divergence of the moiré periodicity and a single narrow red-shifted 2D peak that suggests that the graphene is lattice matched to the hBN substrate. We further analyse the conductivity of the lattice-matched graphene using conductance AFM and observe decreased surface conductance in areas of high strain. We relate our observations to theoretical models of bang gap formation in graphene/hBN heterostructures.

References

[1] A. Summerfield, A. Davies, T. S, Cheng, et al. Sci Rep, 6, (2016), 22440.

[2] A. Davies, J. D. Albar, A. Summerfield, et al. Nano Letters, 18 (2018), 498-504.

Figures

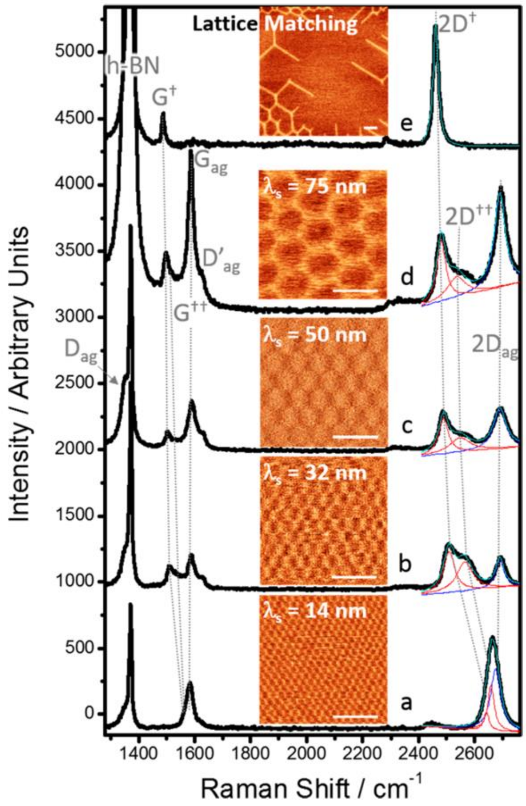

Figure 1: Raman spectra of MBE graphene grown on hBN showing the evolution of **G** and **2D** bands with increasing moiré periodicity from **a** to **e**. (insets) AFM images showing the corresponding increase in moiré period for the samples shown in **a** to **d** with a divergent pattern in **e** for the highest growth temperature of 1710°C in which the graphene is lattice matched. AFM image scale bars all 100 nm.

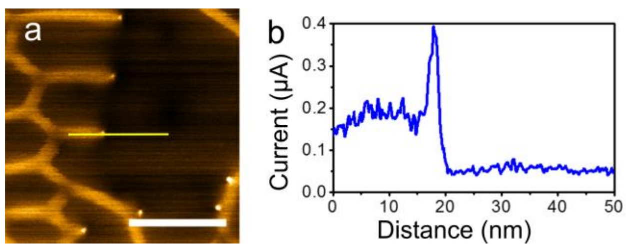

Figure 2: a Conductance AFM image of lattice-matched graphene grown on hBN. Scale bar 50 nm. **b** Conductance profile across the region indicated by the yellow line in **a** showing the decrease in conductance across the lattice matching region. The spike in conductivity is associated with an increased local density of

states due to a lattice dislocation in the graphene monolayer.