MORPHOLOGY AND FORCE SPECTROSCOPY OF EPITAXIAL GRAPHENE GROWN ON Si- AND C-FACES OF SiC

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A rising interest in the scientific community is devoted to the realization of large area graphene flakes for electronic applications [1]. Epitaxial graphene of a good quality can be obtained on both Silicon- and Carbon- terminated basal plane surfaces of hexagonal SiC. The growth on Si-terminated SiC(0001) significantly differs from that on C-terminated SiC(000-1) surface [2]. In this work the morphology of epitaxial graphene has been investigated using Atomic Force Microscopy (AFM). In order to study the variation of the normal force as a function of the thickness of graphene layers, contact force measurements in different areas have been performed on Si- and C-terminated surfaces varying the applied force.
Contact AFM images of graphene obtained on C- and Si-faces using a setpoint of 0.1 V are shown in Fig. 1 (a) and (c), respectively. In both cases, the images evidence the presence of ripples of the graphene layer. Fig. 1 (b) and (d) show that an increased force applied to the AFM cantilever (corresponding to a setpoint of 5 V) significantly modifies the graphene ripples on both samples, without mechanical nano-exfoliation and rupture of the graphene lattice.
The analysis of the shape of the approaching and retracting force plots reveals large adhesion between the tip and the sample in the case of Si- face (Fig. 2(b)) while in the case of the C- face the force curves are distorted (Fig. 2 (a) and Fig. 3 (a)). In the case of the Si basal plane (Fig. 3 (b)), the approaching curves show the typical shape of force spectroscopic data, including small decrease region (attractive force), jump-to-contact, and rapid increase (repulsive force) [4].

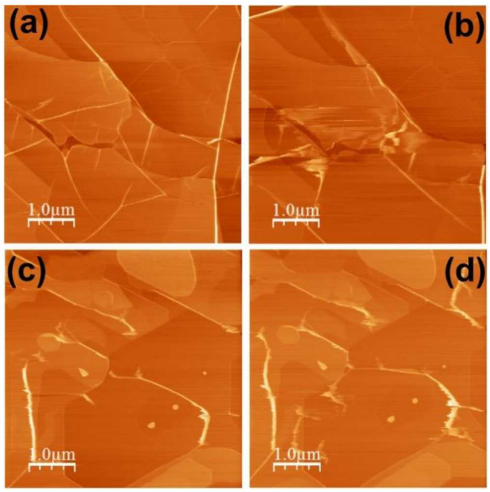

Figure 1: AFM images (5x5 μm^2) of graphene films prepared on C-terminated SiC(000-1) surface using a setpoint of 0.1 V (a) and 5 V (b) and on Si-terminated SiC(0001) surface using a setpoint of 0.1 V (c) and 5 V (d).

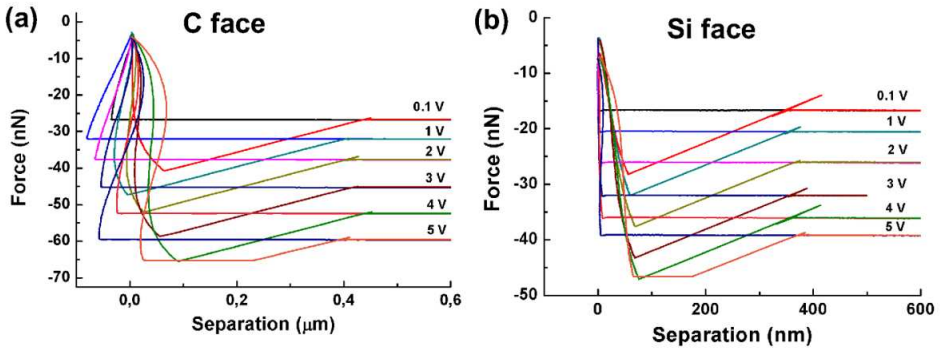

Figure 2: Approaching and Retracting force plots vs separation distance taken at increasing deflection setpoints at a fixed point on the surface of the sample.

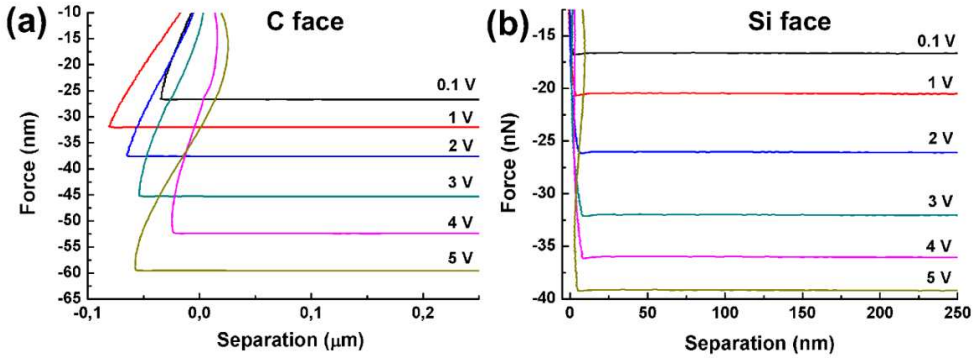

Figure 3: Plots of the approaching forces vs separation distance in the case of graphene grown on C face (a) and Si face (b) of SiC.

References

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