Graphene superlattices fabrication by electron beam activated fluorination

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There has been a rising interest in superlattices of graphene based materials with the ultimate goal of modifying the electronic properties by artificially introducing periodic potentials on the graphene surface. Such lateral periodicities can be hBN/graphene induced Morié patterns. These very systematic modifications cause changes of the electronic structure of graphene in the range of meV or smaller. It thus would be interesting to explore modifications of graphene that can induce stronger changes of the electronic structure. Fluorinated graphene is one such candidate. In our work, the graphene superlattice is fabricated by introducing periodic fluorographene pattern on the graphene surface using electron beam activated fluorination (EBAF) technique.

Fluorographene stripe patterns are fabriacted by EBAF in an SEM equipped with XeF_2 gas injector. When large squares of fluorographene are fabricated, they can easily be detected in LOM images. Though, when nano- and microstripes of fluorographene are deposited, the standard height imaging in the AFM cannot be achieved. For visualising the resulting fluorinated stripes on the graphene surface, we refined adhesion mode imaging in the AFM. One such structure is shown in figure 2c. One clearly sees the fluorinated structure with sharp edges. XPS is used to determine the detailed electronic structure of the fluorographene surface and the spectrum below shows the formation of C-F and C-F_2 bond. Since the fluorographene stripes are clearly delimited, we explore in this work, to which limit the graphene can be structured. We find that nanostructuring with typical feature sizes in the 100nm range is possible and discuss the limits of this novel structuring process.

References

[1] Park, C. H., et al., Nature Physics 4(3): 213-217
[2] Bliokh, Y. P., et al., Physical Review B 79, 075123 (2009)
[3] Li, H., et al., Scientific Reports. 6 (2016)

Figures

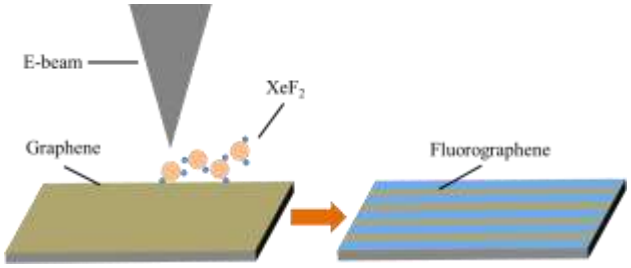

Figure 1: Schematic illustration of electron beam activated fluorination pattern fabrication

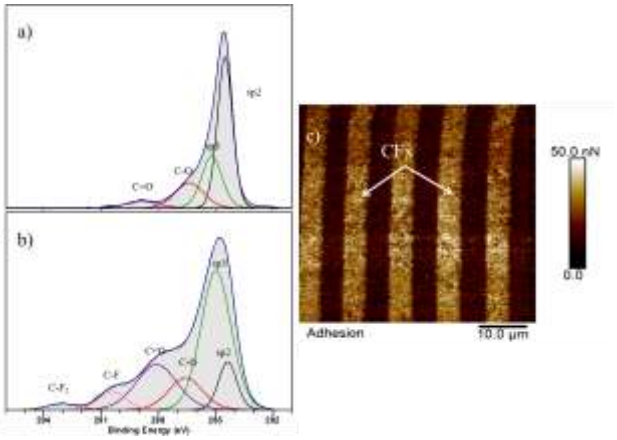

Figure 2: XPS spectra of a) pristine graphene; b) Fluorinated graphene; c) Adhesion mapping of fluorographene pattern