Synthesis of Hydrogen and Fluorine Passivated Diamanes from Graphene on Silicon Carbide

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The miniaturisation of devices has become more challenging due to material and thermal constraints. In order to overcome these limitations, synthesis of diamane (atomically thin diamond-like structures) has attracted interest to develop 2D electronics and spintronics. Recently, diamane was synthesised from bilayer graphene [1] using fluorine from XeF_2 ("F-diamane") on CuNi(111). While this represents significant progress, the CuNi(111) substrate makes it impossible to probe electronic properties of the material and build devices. Synthesis of hydrogen passivated diamane ("H-diamane") [2] has similarly been demonstrated on gold TEM grids. Building upon our previous work in the production of bi- and mono-layer graphene on semiconducting SiC substrates [3][4], we work to passivate graphene on 4H-SiC(0001) using XeF_2. Fluorination has thus far resulted in C-F ratios of between 16 and 25, an example of which can be seen in figure 1B. We also present results on H-diamane synthesis, obtained by exposing graphene on SiC to atomic hydrogen. Following successful synthesis, material-level electrical properties and device-level operational capabilities will be explored.

References

[1] Bakharev, Pavel V., et al., Nature nanotechnology, 15.1 (2020) 59-66
[2] Piazza, Fabrice, et al., Carbon, 169 (2020) 129-133
[3] Zebardastan, Negar, et al., Nanotechnology, 34.10 (2022) 105601
[4] Gupta, Bharati, et al., Carbon, 68 (2014) 563-572

Figures

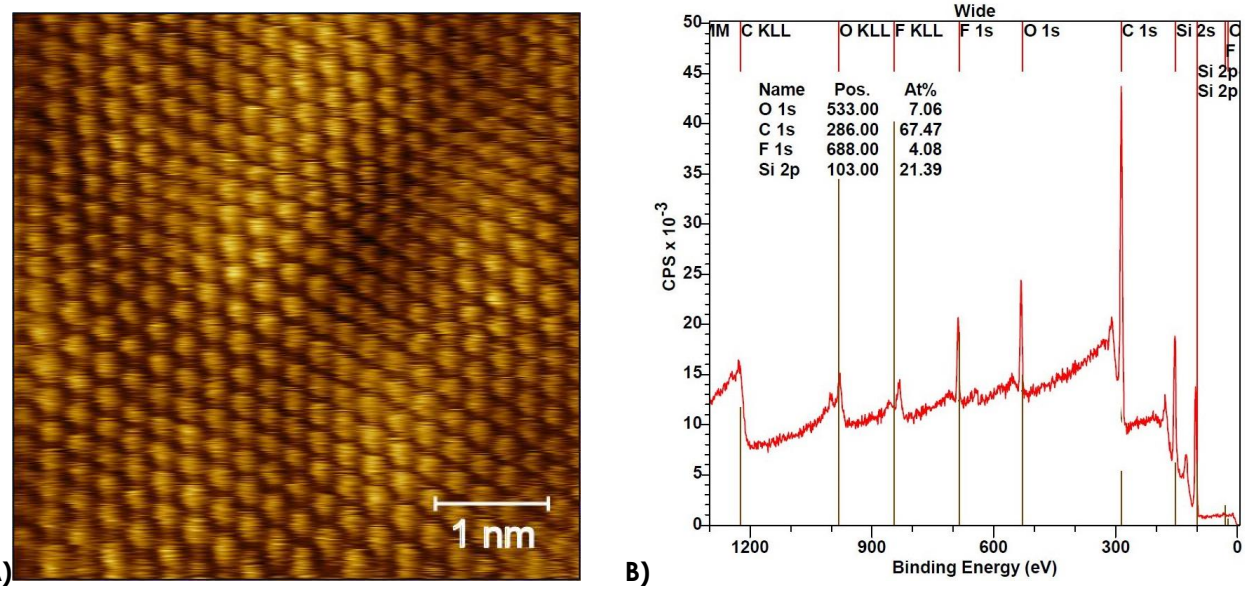

Figure 1: A: Atomic resolution preliminary unfiltered STM image of fluorinated graphene showing preserved graphene-like structure. B: Wide XPS spectrum of the fluorinated sample, showing the presence of fluorine and proportion of fluorine and carbon.