Direct writing of functionalized graphene nanopatterns with tunable bandgaps in FIB

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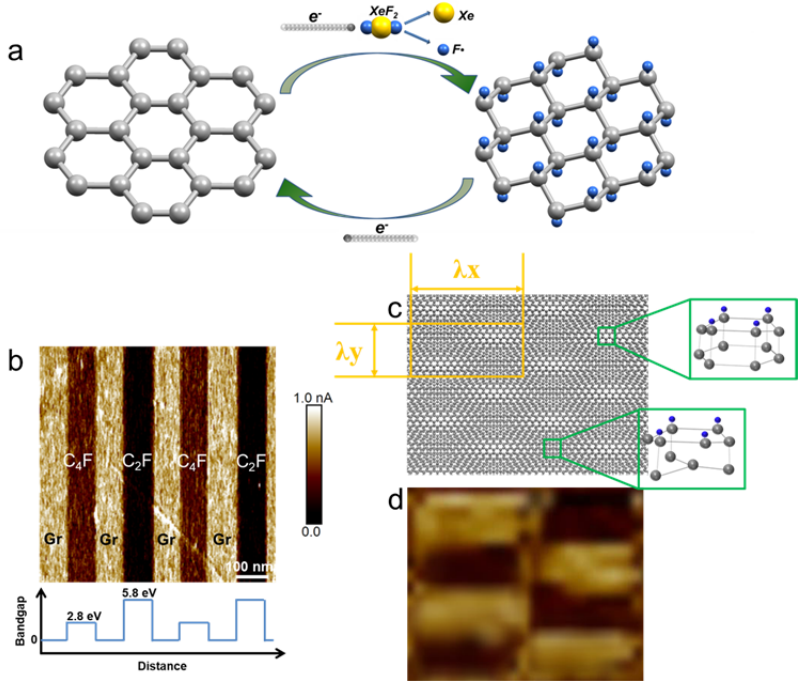
One of the primary goals for monolayer device fabrications and an ideal model of graphene as an atomic thin "canvas" is one that permits semiconducting/insulating lateral nanopatterns to be freely and directly drawn on the semi-metallic graphene surface [1-2]. Here, we demonstrates a reversible electron-beam-activated technique in a FIB/SEM that allows direct writing of semiconducting/insulating fluorographene lateral nanopatterns with tunable bandgaps directly on the graphene surface with a resolution down to 15 nm [3-4]. This approach overcomes the conventional limit of semiconducting C_4F in the single-sided fluorination of supported graphene and achieves the tunability until insulating C_2F. Moreover, applying this technique on bilayer graphene demonstrates, for the first time, a new type of rectangular moiré pattern arising from the generated C_2F boat/graphene superlattice. This novel technique constitutes a new approach to fabricating graphene-based flexible and transparent electronic nanodevices with the C_xF channels utilized as semiconducting or insulating counterparts, and also opens a route toward the tailoring and engineering of electronic properties of such materials in addition to the dominating triangular moiré patterns from a graphene/hBN system.



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