Conversion of Epitaxial Graphene to 2D diamane on Silicon Carbide

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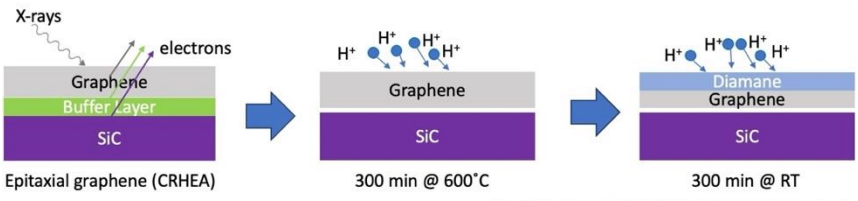
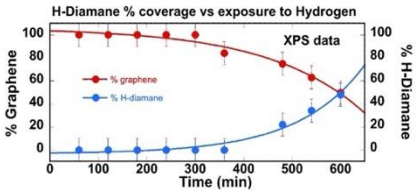
The miniaturisation of devices has become more challenging due to material and thermal constraints. To overcome the limitations of the Moore's law, the synthesis of diamane [1] (atomically thin diamond-like structures) has attracted interest to develop 2D electronics and spintronics.

Drawing upon our established expertise in the production of bi- and mono-layer graphene on semiconducting SiC substrates [2,3], we present a novel approach involving the passivation of graphene on 4H-SiC(0001) utilizing atomic hydrogen under ultra-high vacuum (UHV) conditions [4]. Utilizing in-situ X-ray photoelectron spectroscopy (XPS) measurements at the Australian Synchrotron, we observe the conversion of approximately 50% of the graphene into diamane following 600 minutes of exposure. Additionally, we have achieved the transformation of epitaxial graphene into F-diamane through fluorination in a 10% F_2 in N_2 atmosphere at 70°C for 60 minutes. Our next steps involve probing the samples for their electrical properties and evaluating the device capabilities of these materials.





[1] Piazza, Fabrice, et al., Carbon, 169 (2020) 129-133

[2] Zebardastan, Negar, et al., Nanotechnology, 34.10 (2022) 105601

[3] Gupta, Bharati, et al., Carbon, 68 (2014) 563-572

[4] Reynolds, Michael et al. In preparation (2024)