Diamane and diamanoids as new non-vdW 2D materials

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Diamane and diamanoid are promising new wide band-gap semiconducting materials for electronics, photonics and medical devices. Diamane was prepared from the exposure of bi-layer (2LG) graphene to H radicals produced by the hot-filament process at low pressure and low temperature [1,2]. A sharp sp^3-bonded carbon stretching mode was observed in UV Raman spectra at around 1344-1367 cm^{-1} while no sp^2-bonded carbon peak was simultaneously detected (Figure 1). By replacing 2LG with few-layer graphene (FLG), diamanoid/graphene hybrids were formed from the partial conversion of FLG [2,3]. Raman spectroscopy, electron diffraction and Density Functional Theory calculations show that partial conversion generates twisted 2LG located at the interface between the upper diamanoid domain and the non-converted graphenic domain underneath. C-H bonding in the basal plane of hydrogenated FLG, where carbon is bonded to a single hydrogen over an area of 150 μm^2, is directly evidenced by Fourier Transform Infrared microscopy and possible full hydrogenation of diamane is supported by first principle calculations. The results are comprehensively discussed. They open the door to large-scale production of diamane, diamanoids and diamanoid/graphene hybrids, as new carbon 2D materials.

[1] F. Piazza, K. Cruz, M. Monthioux, P. Puech, I. Gerber, Carbon, 169 (2020) 129
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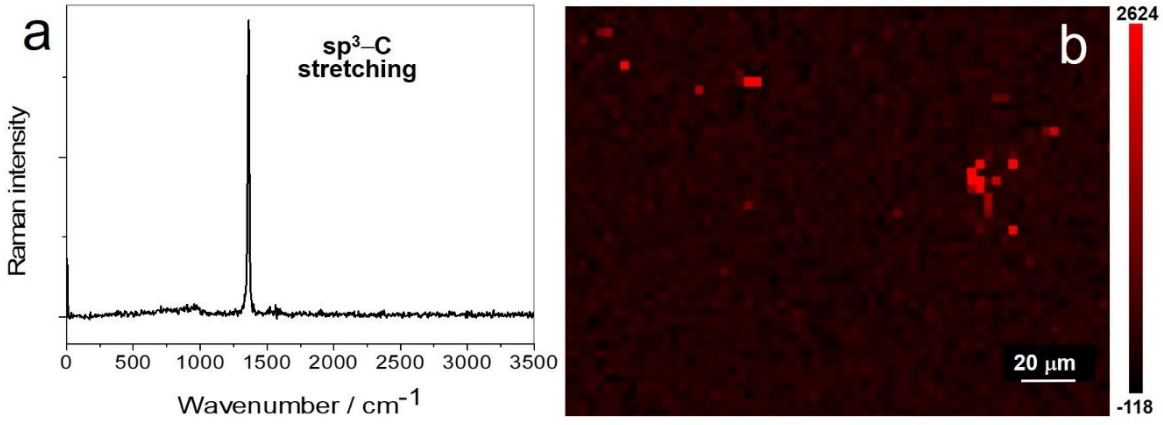

Figure 1. Typical UV Raman data for 2LG exposed to the hot-filament-promoted hydrogenation process. **(a)** Example of spectrum; **(b)** example of intensity map of the sp^3–C stretching mode.