Two-Dimensional Hexagonal Copper Iodide

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Abstract. Two-dimensional (2D) materials have emerged as promising candidates for next-generation electronic and optoelectronic applications. Some 2D materials have been successfully synthesized or exfoliated, while many more candidates are proposed [1]. Graphene has a privileged position among them as the first isolated 2D structure studied for its peculiar properties. The chemical inertness and simplicity of its atomic structure also makes graphene a most suitable substrate for stabilizing less obvious 2D structures. One such example is the 2D SiO2 squeezed between graphene layers [2], otherwise forming only stable 3D crystalline and amorphous configurations. Very recently, using scanning transmission electron microscopy (STEM), we discovered an entirely new 2D material, 2D hexagonal CuI, confined between 2 layers of graphene. To our knowledge, 2D h-CuI, has not been previously observed yet. The 3D "parent" structure is a well-known wurtzite CuI crystal. The band structure of 2D h-CuI has also been calculated [1] showing a bandgap of ~2 eV and very flat electronic bands close to the Fermi level. We obtained a precise atomic configuration using the scanning transmission electron microscopy (STEM) imaging and the chemical characterization with electron energy loss spectroscopy (EELS), both in atomic resolution. The lattice constant in the 2D hexagonal structure of h-CuI is 0.416 nm, which is almost twice of that in graphene (0.246 nm). We also found evidence for the important role of graphene in stability of 2D h-CuI.

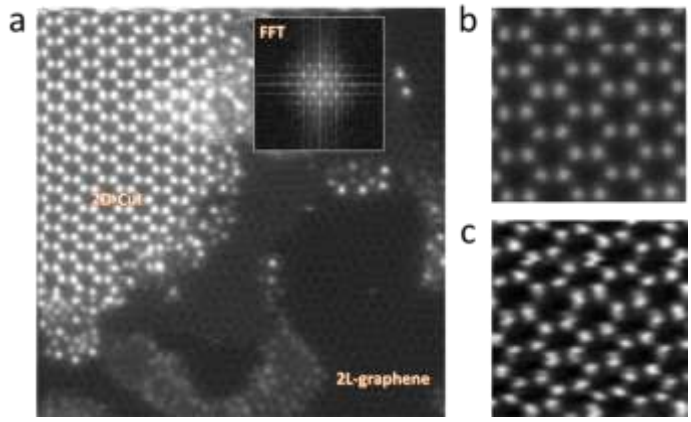

Figure: (a) Medium-Angle Annual Dark-Field (MAADF) image of 2D h-CuI in a bilayer graphene sandwich structure, Inset: Fast Fourier Transform (FFT) of the entire image area. (b) High-Angle Annual Dark-Field (HAADF) image of 2D h-CuI of the small crystal area while measuring the EELS map of the iodine edge $M_4 3d_{3/2}$ in same area imaged in (c). The side of the imaged square in (b) and (c) measures 2 nm.

REFERENCES

[1] Nicolas Mounet, *et al*., Nature Nanotechnology **13,** 246–252(2018)
[2] Pinshane Y. Huang, *et al*., Nano Letters **12**, 1081−1086 (2012)