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Towards optimized preparation of few-layer antimonene and unveiling its oxidation tendency

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Abstract

Antimonene, a monolayer of β-antimony, has recently become the focus of intense research owing to its intriguing semiconducting properties, good electronic mobility and chemical reactivity, which makes it highly desirable for applications in (opto)electronics, energy storage, and organic catalysis, to name a few[1]. Beyond other 2D materials, antimonene is of particular interest because of its high thermodynamic stability under ambient conditions as well as its predicted 2D topological feature stemming from its intrinsic spin–orbit coupling property[2]. However, the absence of a reliable method for the preparation of high-quality antimonene in large quantities hinders the development of antimonene-based devices despite the tremendous efforts devoted for this end[3]. Here, we present a systematic optimization of the preparation of Few-layer antimonene (FLA) through top-down methods, namely liquid-phase exfoliation and mechanical delamination, while simultaneously deciphering its structural and morphological characteristics using a set of upfront characterization techniques. Moreover, and whilst the surface chemistry of several 2D-materials and their oxygen-sensitivity have been fully addressed[4], the oxidation behavior of antimonene remains poorly investigated. In this regard, we conducted an insightful investigation of the oxidation behavior of FLA and complemented the obtained results with DFT calculations. This work pushes forward the controlled synthesis of FLA via simple and facile methods and yields valuable information on its oxidation tendency, thus paving the way towards its potential application in various technologies.

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