Continuous-flow synthesis of high-quality few-layer antimonene hexagons

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A novel family of layered materials from group-15 of the Periodic Table, called Pnictogens (P, As, Sb and Bi) have gained increasing attention due to their semiconducting behaviour, with thickness-dependent band gaps that can be modulated by strain, doping or chemical functionalization, which can be useful for fabricating optoelectronic devices. Additionally, these 2D-Pnictogens offer unique photonic, catalytic, magnetic, and electronic properties. [1] Within this chemical group, antimonene is a monoatomic 2D material with a buckled structure showing exceptional physico-chemical properties. Although some of its theoretically-predicted remarkable properties have already been experimentally demonstrated, others remain a challenge to corroborate because of the absence of a suitable synthetic method to produce the required high-quality material. [2] Antimonene can be isolated using top-down and bottom-up approaches. On the one hand, top-down methods such as micromechanical or liquid phase exfoliation have demonstrated the ability to produce limited lateral dimensions and partially oxidized hexagonal antimonene nanoflakes. [3] On the other hand, bottom-up methods as well as molecular beam epitaxy and van der Waals epitaxy approaches, have led to high-quality antimonene flakes but are not suitable for large-scale synthesis. [4] Another bottom-up approach has been recently reported, involving a solution phase synthesis of well-defined hexagonal few-layer antimonene via anisotropic growth, [5] which has facilitated large-scale production of this material. In this context, we optimized the synthetic parameters for the production of high quality few-layer antimonene hexagons, and their implementation in a large-scale manufacturing process under continuous-flow conditions to pave the way for optoelectronic device fabrication.

REFERENCES

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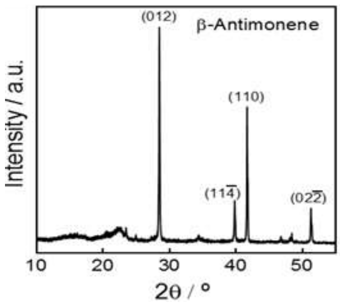
FIGURES



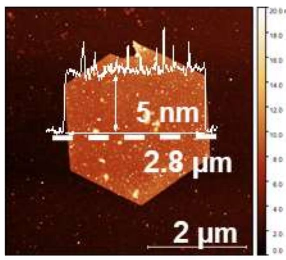


Figure 1: X-ray powder diffraction (left) and atomic force microscopy image (right) of hexagonal antimonene nanosheets synthesized using a colloidal chemistry approach.