Hexagonal hybrid bismuthene by molecular interface engineering

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High-quality devices based on layered heterostructures typically require materials obtained through complex solid-state physical approaches or laborious mechanical exfoliation and transfer. Wet-chemically synthesized materials are not commonly used due to their surface residuals and intrinsic defects. Here, we introduce a new two-dimensional (2D) member to the pnictogen family (group 15 of the Periodic Table), synthetized by a colloidal approach [1,2], that consists of a coherent sandwich of beta-bismuth, encapsulated by sulfur-alkyl-functionalized flat bismuthene interfaces [3,4]. While an unprecedented degree of structural quality is demonstrated, an altered atomic arrangement of the outermost, functionalized bismuthene layers leads to a drastic change in the chemical reactivity and electronic structure especially when compared to other heavy pnictogen: antimonene[5–7]. The metallic behaviour of the hybrid is supported by *ab initio* predictions and room temperature transport measurements of individual nanoflakes. Our findings indicate how surface reconstructions in 2D systems can promote unexpected properties that can pave the way to new functionalities and devices. Moreover, this scalable synthetic process opens new avenues for applications in plasmonics or electronic (and spintronic) device fabrication. Beyond electronics, this 2D hybrid material may be of interest in organic catalysis[8], biomedicine, or energy storage and conversion[2]. Last but not least, a large-scale production strategy will be introduced.[9]

References

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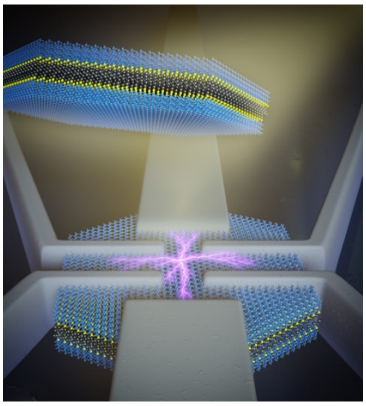

Figure 1: The illustration shows the synthesis of a few-layer bismuth hybrid with electronic grade structural quality and unique surface reconstruction.