2D Antimonene Hexagons as anodes for K-Ion Batteries

B. González-Tobío[1]
X. Du[2], D. Rodriguez-San-Miguel[1,3], V. Nicolosi[2], F. Zamora[1,3,4]
1. Departamento Química Inorgánica, Universidad Autónoma de Madrid, Madrid, Spain.
2. School of Chemistry, CRANN & AMBER Research centres, Trinity College Dublin, Dublin, Ireland
3. Institute for Advanced Research in Chemical Science (IAdChem), Universidad Autónoma de Madrid, Madrid, Spain.
4. Condensed Matter Physics Center (IFIMAC), Universidad Autónoma de Madrid, Madrid, Spain.
brais.gonzalez@uam.es

Potassium-ion batteries (KIBs) are a promising alternative to lithium-ion batteries (LIBs) because potassium has a higher earth abundance (2.79 wt.% vs 0.0017 wt.% Li) and the redox couple K/K^+ exhibits better standard electrode potential (-2.93 V vs. E_0) than Na/Na+ (-2.71 V vs. E_0), approaching the Li/Li+ standard electrode potential (-3.04 V vs. E_0). Allowing KIBs to operate at higher potentials than sodium-ion batteries (NIBs) could lead to higher energy density while still using an abundant element.[1] In addition, it has been observed that the K/K^+ couple shows more negative potential in some organic electrolytes, such as propylene carbonate than the Li/Li^+ and Na/Na^+ pairs.[2] The most commonly used anodes in KIBs are carbonaceous anodes with a long cycle life, but they are very limited by their capacity, usually below 300 mA h g^{-1}. [3-5] Therefore, alloy anodes have recently been explored. Within this type, Sb-based electrodes deserve special mention due to their low working potential and high theoretical capacity (660 mA h g^{-1}). The formation of the K_3Sb alloy upon complete potassation indicates that Sb is one of the metals that can alloy the largest number of K atoms.[6] Herein, we present the use in KIBs of an anode of few-layer antimonene hexagons uniformly mixed with carbon nanotubes (CNT). Our Sb/CNT anode delivers a high capacity of 520 and 420 mA h g^{-1} at current densities of 100 and 500 mA g^{-1}, respectively, remaining stable for more than 180 cycles.

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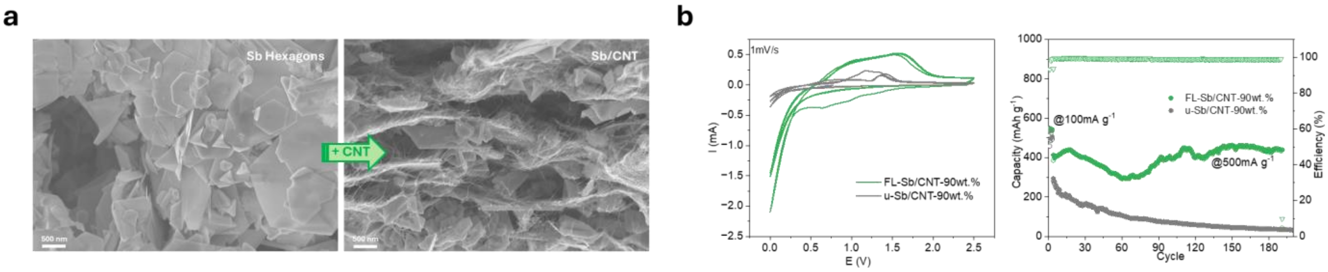

Figure 1: a) Scanning electron microscopy images of few-layer antimonene hexagons and Sb/CNT electrode. b) Electrochemical performance of Sb/CNT anode.

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