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Sol-Gel elution synthesis of bismuth oxide thin film for high energy storage performance

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The need of achieving low-impact and low-cost functional materials through sustainable and efficient methodologies is one of the goals of the current research in the field of materials science and energy storage. In this study, a new facile route for obtaining battery-like Bi-based films, grown on titanium foils, is presented and discussed. Specifically, β-Bi_2O_3 layers were prepared from oxynitrate precursors via a simple sol-gel/elution process upon self-standing titanium foils, followed by annealing in forming gas (H_2/N_2 5/95) at the temperature of 350°C. Through a comparative multi-technique approach, we demonstrate that the reducing H_2 environment is mandatory for the formation of a crystalline bismuth oxide edifice which consists of the tetragonal β-Bi_2O_3 phase with the crucial presence of Bi^0. The technique allows to have a robust interfacial connection between the Bi-active layer and the conductor, thus avoiding other sample manipulation and guarantying stability. The article discusses the structural properties and the electrochemical characterization of the bivalent Bi-phase, to analyse the energy storage performance of the obtained material. The electrochemical characterization was conducted through Cyclic Voltammetry (CV) and Galvanostatic Charge Discharge (GCD) analyses thus revealing a peculiar double-redox battery behaviour with specific capacity (specific capacitance) of 195 mA*h/g (350 F/g) at 0.5 A/g, which highlights its energy storage potential.