Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

What about Electrochemical Behaviors for Aurivillius-Phase Bismuth Tungstate? Capacitive or Pseudocapacitive

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1. Experimental

1.1 Chemicals and reagents

All the reagents used in the experiment were of analytical grade and used without further purification. Bismuth nitrate pentahydrate ($Bi(NO_3)_3 \cdot 5H_2O$) and Sodium Tungstate Dihydrate ($Na_2WO_4 \cdot 2H_2O$) were purchased from Sinopharm Chemical Reagent Co. Ltd (Shanghai, China). Anhydrous ethanol (C_2H_5OH) and concentrated sulfuric acid (H_2SO_4) were purchased from Damao Chemical Reagent Factory (Tianjin, China). Steel mesh (99.99%, 1.7 mm) was purchased from Lizhiyuan Co, Ltd (Shanxi, China). Deionized water with a resistivity of > 10.0 MΩ was used in experiments.

1.2 Electrochemical evaluation

The capacitive effects are characterized by analyzing the cyclic voltammetry data at various sweep rates according to:

$$\mathrm{i} = a\nu^{b} \tag{1}$$

where the measured current *i* obeys a power law relationship with the sweep rate ν. Both *a* and *b* are adjustable parameters, with *b*-values determined from the slope of the plot of log *i* vs log ν. In the eqn, the *b*-value is 0.5, the electrode material behaves as a battery property, while the *b*-value is 1, the electrode material exhibits pseudo-capacitance properties. And materials with the *b*-value in the range of 0.5-1 generally exhibit battery properties and pseudocapacitance properties.

Dunn et al. developed an approach to analyze the storage mechanism from the CV curve, where the current response at a fixed potential as being the combination of two separate mechanisms, surface capacitive effects and diffusion-controlled insertion processes:

$$\mathrm{i}_{(\mathrm{V})} = k_1\nu + k_2\nu^{1/2} \tag{2}$$

Where $\mathrm{i}_{(\mathrm{V})}$ is the current response at a fixed potential, ν is the sweep rate, k_1 and k_2 are constant at the fixed potential. For analytical purposes, we rearrange this slightly to

$$i(V)/\nu^{1/2} = k_1\nu^{1/2} + k_2 \tag{3}$$

In eq (3), $k_1\nu$ and $k_2\nu^{1/2}$ correspond to the current contributions from the surface capacitive effects and the diffusion-controlled intercalation process, respectively. Thus, by determining k_1 and k_2, we are able to quantify, at specific potentials, the fraction of the current due to each of these contributions.