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Supporting Information

Dicranopteris-Like Fe-Sn-Sb-P alloy as a promising anode for Lithium ion Batteries

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Experimental

Mesurement of Linear sweep voltammetry (LSV) of electrodeposition of Fe-Sn-Sb-P alloy:

Linear sweep voltammetry of the electrodeposition of Fe-Sn-Sb-P alloy was carried out on an electrochemistry working station CHI660C (Chenhua Co. Ltd., Shanghai, China). A conventional three-electrode cell was used. The solutions were deoxygenated with nitrogen gas. The working electrode was copper disc electrode, with a surface area of 0.28 cm^2. The reference electrode was saturated calomel electrode (SCE), and all potentials are quoted with respect to this. A platinum counter electrode was used during linear potential sweep process. The pH value was adjusted to 2. All these reagents are analytical reagents, and were purchased from Sinapharm Chemical Reagent Co. Ltd.

The bath compositions are as follows:

Fe-P solution: 40g L^{-1} H_3BO_3, 60g $L^{-1}NH_4Cl$, 40g L^{-1} $NaH_2PO_2 \cdot H_2O$, 10g L^{-1} $FeCl_2 \cdot 4H_2O$, 40g $L^{-1}NH_4Br$, 2g L^{-1} ascorbic acid;

Fe-Sb-P solution:40g L^{-1} H_3BO_3, 60g $L^{-1}NH_4Cl$, 40g L^{-1} $NaH_2PO_2 \cdot H_2O$, 10g L^{-1} $FeCl_2 \cdot 4H_2O$, 40g $L^{-1}NH_4Br$, 8 g L^{-1} antimony potassium tartrate and 2g L^{-1} ascorbic acid;

Fe-Sn-Sb-P solution: 40g L^{-1} H_3BO_3, 60g $L^{-1}NH_4Cl$, 40g L^{-1} $NaH_2PO_2 \cdot H_2O$, 10g L^{-1} $FeCl_2 \cdot 4H_2O$, 20g L^{-1} NH_4Br, 8 g L^{-1} antimony potassium tartrate and 2g L^{-1} ascorbic acid, 2 g L^{-1} $SnCl_2 \cdot 2H_2O$;

***Materials preparation*:** The Fe-Sn-Sb-P alloy electrode was prepared by

electroplating on coarse copper foil. The coarse copper foil was rinsed by dilute H_2SO_4 (5 wt%) prior to electroplating. The composition of electroplating bath contains 40 g L^{-1} H_3BO_3, 60 g L^{-1} NH_4Cl, 40 g L^{-1} $NaH_2PO_2 \cdot H_2O$, 20 g L^{-1} NH_4Br, 10 g L^{-1} $FeCl_2 \cdot 4H_2O$, 4 gL^{-1} $SnCl_2 \cdot 2H_2O$, 8 g L^{-1} antimony potassium tartrate and 2 g L−1 ascorbic acid. The mixture was stirred at ambient temperature and the bath pH value was adjusted to 1.5 with dilute HCl (5 wt%). A platinum-plated Ti mesh was served as anode. The electroplating was lasted for 2 min with a constant current density. The mass ratio of composition is varied with current density. Electrochemical deposition process was performed at room temperature with stirring. After deposition, the electrodes were rinsed with dilute water for 3 times and then dried at 80 ºC in vacuum atmosphere for 12h before measurements.

***Materials Characterization*:** The sample morphologies and crystallographic information of the electroplated Fe-Sn-Sb-P films were investigated by using field emission scanning electron microscopy (JXA-8100 SEM, Hitachi S-4800 SEM system) and X-ray diffraction (XRD, Philips X'Pert Pro Super X-ray diffractometer, Cu-Kα radiation, at 2° min^{-1} scan rate). The elemental compositions of the samples were analyzed with energy-dispersive X-ray spectroscopy (EDX) attached to the Hitachi S-4800 SEM.

***Electrochemical Measurements*:** Electrochemical discharge-charge behaviors were investigated directly using 2025 coin cells assembled in an argon-filled glove box with water and oxygen contents less than 0.5 ppm. The cell was made from a Fe-Sn-Sb-P alloy cathode and a lithium anode. The electrodes were separated by a polypropylene (PP) film (Celgard 2400) separator. The electrolyte reservoir was made from $LiPF_6$ (1.0 M) in a mixture of ethylene carbonate (EC)/dimethyl carbonate (DMC)/diethyl carbonate (DEC) 1:1:1 (vol% provided by Guangzhou Tinci Materials Technology Co., Ltd., China) with 2wt% vinylene carbonate (VC) as additive. The cells were galvanostatically discharged and charged in a battery test system (LAND-V34, Land Electronic Co., Ltd., Wuhan, China) with a constant current density of 100 mA g^{-1} at a cut-off voltage of 0.02–1.5V (versus Li/Li^+) at room temperature.

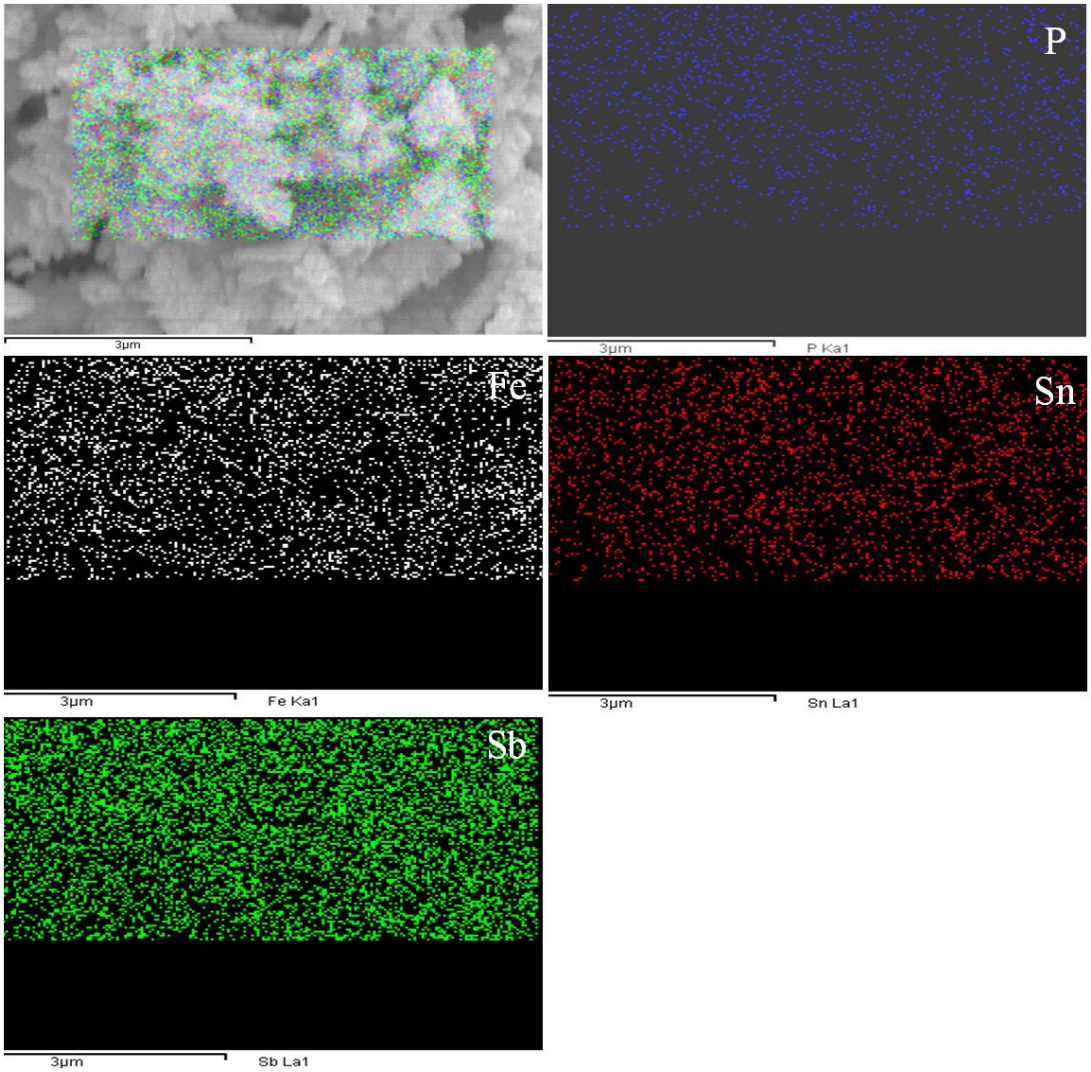

Fig.S1 SEM and EDS mapping images