

Electronic Supplementary Information

For

Significantly Increased Cycling Performance of Novel “Self-Matrix” NiSnO₃ Anode in Lithium Ion Battery Application

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Synthesis of NAS and NSO electrodes

A mixture of NiO and SnO₂ (marked NAS) was synthesized by a polymerized complex technique. In a typical procedure, tin(II) acetate (Sn(CH₃COO)₂, 0.1 mol) was dissolved in the solvent of ethylene glycol (0.4 mol), and subsequently anhydrous citric acid (0.1 mol) was added to the obtained solution and fully dissolved at 50 °C for 3 h. Next nickel(II) acetate (Ni(CH₃COO)₂, 0.1 mol) was added and the resultant mixture was stirred at 80 °C for 6 h. After that, the obtained transparent solution was heated at 135 °C for 48 h to remove the excess solvent and to promote polymerization. Obtained powder was heated at 350 °C for 5 h, and then at 600 °C for 10 h in the muffle furnace. In comparison, commercial nanoscaled nickel tin oxide (NiSnO₃, NSO) powders was dried at 100 °C for 72 h under vacuum, and then used without further purification.

Characterization of NAS and NSO electrodes

The X-ray diffraction patterns were performed using a D-5000 diffractometer operated at 40 kV and 40 mA, with Cu K α radiation ($\lambda=0.154056$ nm) at a scanning rate of 2° min⁻¹ between 10° and 90° of 2 θ angle. The Raman spectra were recorded on an RFS-100 Bruker FT-spectrometer using an Nd:YAG laser with an excitation wavelength of 1064 nm. Each spectrum was the average of 60 repeated measurements, with 150 scans at a resolution of 2 cm⁻¹. Field emission scanning electron microscope (FESEM) was applied using a JEOL JSM-6330F SEM operated at 15 kV.

Electrochemical performance of NAS and NSO electrodes

Anode electrodes were prepared by slurry-casting on copper foils that served as current collectors. The slurry contained 80 wt% active materials (NAS or NSO), 10 wt% carbon black, and 10 wt% poly(vinylidene) fluoride binder in the N-methylpyrrolidinone (NMP) solvent. As-obtained electrodes were dried in a vacuum oven at 90 °C overnight, and were cut to 9/16 inch in diameter for the electrochemical performance testing. CR-2032-type coin cells were assembled as the electrochemical cells in a glove box filled with a dry argon atmosphere (moister and oxygen concentration < 1 ppm). As-prepared anode electrodes were employed as working electrode and Li sheet as counter electrode. Celgard 2400 micro porous polypropylene was used as the separator. The electrolyte was 1M lithium bis(perfluoroethylsulfonyl)imide dissolved in ethylene carbonate (EC): diethyl carbonate (DEC): ethyl methyl carbonate (EMC) in a 1:1:1 volume ratio. Cyclic voltammetry were performed on a Versatile Multichannel Potentiostat (VMP3) at a scan rate of 0.1 mV s⁻¹ over a potential range of 0.02~3.0 V (vs. Li/Li⁺). All

electrochemical cells were galvanostatically cycled between 0.02 and 3.0 V (vs. Li/Li⁺) at room temperature by NEWARE BTS-610 battery tester.