

Enhanced Energy Storage and Rate Performance Induced by Dense Nanocavities inside MnWO₄ Nanobars

En Zhang,^b Zheng Xing,^a Ji Wang,^b Zhicheng Ju,^{*a} and Yitai Qian^{a,b}

^a Hefei National Laboratory for Physical Sciences at Microscale and Department of Chemistry, University of Science and Technology of China, Hefei, Anhui, 230026, P. R. China. Fax: +86-551-360-7402; Tel: +86-551-360-1589; E-mail: juzc@ustc.edu.cn

^b School of Chemistry and Chemical Engineering, Shandong University, Jinan, 250100, P. R. China

Experimental section

All reagents were analytical purity, and purchased from Shanghai Chemical Reagents Company without further purification.

Synthesis of MnWO₄ Nanobars: Equimolar amount of MnCl₂·2H₂O, Na₂MoO₄ and appropriate amount of PVP were dissolved in 40 mL of distilled water to form a homogeneous aqueous solution. The resulting mixture was loaded into an autoclave in an electric oven at 140-180 °C for a period of 8-14 h. After heating, the autoclave was cooled down to room temperature naturally. The solid product was harvested by centrifugation and washed with deionized water several times and acetone once before 80 °C vacuum drying.

Sample Characterization: The X-ray powder diffraction (XRD) patterns of the products were carried out by a Bruker D8 advanced X-ray diffractometer equipped with Cu K α radiation ($\lambda=1.5418$ Å). Transmission electron microscopy (TEM) images were taken on a JEM-1011 transmission electron microscope, using an accelerating voltage of 100 kV. The high-resolution transmission electron microscopy (HRTEM) images and the selected area electron diffraction (SAED) patterns were taken on a JEM-2100 transmission electron microscope.

Electrochemical Measurements: The electrochemical performance versus Li were carried out using coin-type cells (size: 2032). To prepare the working electrodes, the active materials (70 wt %), conductivity agent (Super P carbon black) (20 wt %) and binder (polyvinylidene fluoride) (10 wt %) dissolved in N-methyl pyrrolidone (NMP) were mixed and ball milled (QM-3SP2 Planetary Ball Mill produced by Nanjing University Instrument plant) at 400 rpm for 5 hours. Then the slurry was coated on a Cu foil and dried under vacuum at 80 °C for 24 hours. Li metal was applied as anode. The separator was Celgard 2300 microporous membrane, and the electrolyte was 1 M LiPF₆ solution dissolved in ethylene carbonate/dimethyl carbonate (EC/DMC) by 1:1 volume ratio. The coin cells were assembled in the argon-filled glove box (Mikrouna, Super 1900) with the concentrations of moisture and oxygen below 1 ppm, and galvanostatic charge/discharge cycling were performed using LAND-CT2001A multichannel galvanostat (Wuhan, China) in the voltage range of 0.01-3.0 V (vs. Li⁺/Li) at room temperature. The cyclic voltammetry (CV) profiles were carried out in the voltage window 0.01-3.0 V at a scan rate of 0.1 mV/s with an electrochemical workstation (LK-2005A).

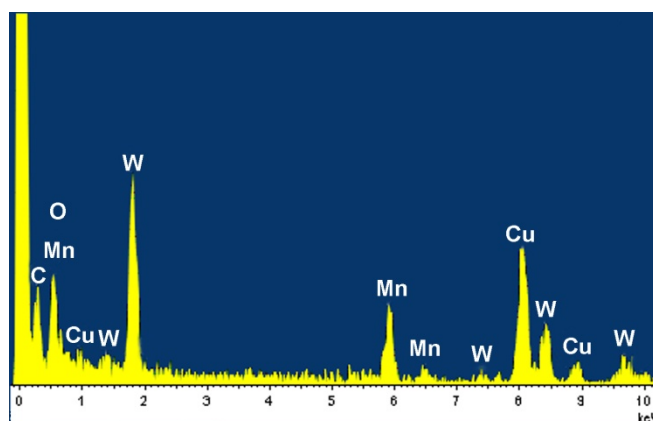


Fig. S1. The EDS spectrum of the MnWO₄ nanobars.

The corresponding EDS spectrum showed that the element here is mainly for W, Mn and O, while the peaks of Cu and C signal in the spectrum originates from the copper support of the specimen.

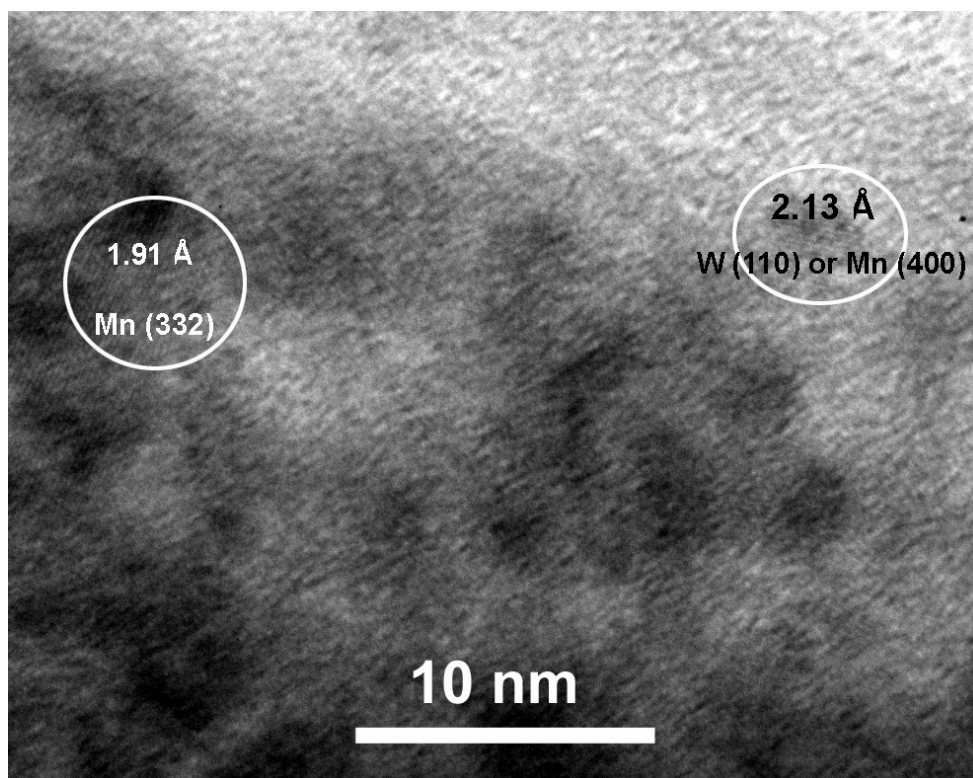


Fig. S2. The HRTEM image of MnWO₄ nanobars.