

Electronic Supplementary Information to an article:

Dynamic Charge Acceptance And Hydrogen Evolution Of New MXene Additive In Advanced Lead-Acid Batteries Via A Rapid Screening Three-Electrode Method

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Experimental

1. MXene preparation

The 1.0 g Ti_3AlC_2 MAX powder ($< 74 \mu\text{m}$ particle size, Forsman Scientific Co., Ltd.) was immersed in aqueous 50 mL 10% HF solution (ACS, Sigma-Aldrich) and stirred under a magnetic stirring hot plate for 150 h at room temperature. The Ti_3C_2 MXene sample was finally collected after thoroughly washing with deionized water and dry in vacuum oven at 40°C .

2. Structure characterizations

Low-magnification morphology of the electrode materials was collected on a Hitachi S4800 ultra-high resolution field emission scanning electron microscopy (FESEM) equipped with energy-dispersive X-ray spectroscopy (EDX). Transmission electron microscopy (TEM) images were captured at 300 kV on a Hitachi H-9000NAR electron transmission microscope with an attached Noran energy dispersive spectrometer and a Gatan multi scan CCD camera controlled by an Emispec Vision 2 data acquisition system.

3. Electrochemical measurements

The electrochemical measurement was conducted on a Potentiostat/Galvanostat/ZRA (Reference 600+, Gamry Instruments) using a thermostat-controlled standard three-electrode cell with Ag/AgCl electrode as reference and a graphite rod as counter electrode. The porous graphite plate (PGP, Sur-Seal Inc.) was peeled to remove the inside metal net and then was used as working electrode. In typical experiments, lead slurry was prepared with a mixture of lead powder ($\sim 70\%$ PbO), Vanisperse

A (0.3 wt%), BaSO₄ (0.75 wt%), MXene or monolayer graphene (Acros Organics) and/or CB (Johnson Controls, Inc.), and H₂SO₄ (1.28 g/mL, ACS, Sigma-Aldrich). The received slurry was then coated on the PGP electrode and dried at room temperature. The loading of electrode materials is ~2 g/cm². The H₂SO₄ solution was used as electrolyte during the measurement. The CV curve was tested from -0.8 to 0 V with a scanning rate of 0.3 mV/s at room temperature.