Supporting Information

MoS_2 nanosheets with expanded interlayer spacing for ultrastable aqueous Mg-ion hybrid supercapacitor

Guodong Pan[a], Junfeng Li [a,b*], Lu Han[c], Wenwu Peng[a], Xingtao Xu[d], Ting Lu[a], Mohammed A. Amin[e], Yusuke Yamauchi[f], Min Xu [a*] and Likun Pan[a*]

[a] Shanghai Key Laboratory of Magnetic Resonance, School of Physics and Electronic Science, East China Normal University, Shanghai 200241, P. R. China

[b] College of Logistics Engineering, Shanghai Maritime University, Shanghai 201306, P. R. China

[c] Key Laboratory of Spin Electron and Nanomaterials of Anhui Higher Education Institutes, Suzhou University, Suzhou 234000, P. R. China

[d] JST-ERATO Yamauchi Materials Space-Tectonics Project and International Center for Materials Nanoarchitectonics (WPI–MANA), National Institute for Materials Science (NIMS), 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan

[e] Department of Chemistry, College of Science, Taif University, P.O. Box 11099, Taif 21944, Saudi Arabia.

[f] School of Chemical Engineering and Australian Institute for Bioengineering and Nanotechnology (AIBN), The University of Queensland, Brisbane, QLD 4072, Australia

*Corresponding author: Email: lkpan@phy.ecnu.edu.cn (Likun Pan); xumin@phy.ecnu.edu.cn (Min Xu); jfli@shmtu.edu.cn (Junfeng Li)

1. Materials.

$Na_2MoO_4 \cdot 4H_2O$, thioacetamide, 1-methyl-2-pyrrolidone, MgSO4, carbon black, and polyvinylidene fluoride were purchased from Sinopharm Chemical Reagent Co., Ltd. The raw AC material was produced by Kuraray (Shanghai) Co., Ltd.

2. Material characterizations

The morphologies and structures of the samples were measured by scanning electron microscopy (SEM, JSM 7500F, JEOL), transmission electron microscopy (TEM), and high-resolution TEM (HR-TEM, JEM 2010 JEOL). X-ray diffraction (XRD) pattern was recorded by X-ray diffractometer (Holland Panalytical PRO PW 3040/60, V = 35 kV, I = 25 mA, λ=1.5418 Å).

3. Electrochemical measurements

Cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), and electrochemical impedance spectroscopy (EIS) tests were conducted using an electrochemical workstation (Autolab PGSTAT302N). The cycling stability measurement was carried out on a LAND battery-testing instrument with a sweep charge and discharge rate at 5 A $\cdot g^{-1}$ for 30000 cycles.

The specific capacitance Cs (F g^{-1}) of supercapacitor was calculated from the GCD process according to the following equation:

$$Cs = \frac{I \times \Delta t}{\Delta V \times m} \quad (1)$$

where I (A) represents the discharge current, Δt (s) corresponds to the discharge time, ΔV (V) is the potential window, and m (g) is the mass of active materials.

The energy density and power density of supercapacitor were evaluated according to

the following equations:

$$E = \frac{C \times (\Delta V)^2}{2 \times 3.6} \tag{2}$$

$$P = \frac{E \times 3600}{t} \tag{3}$$

where E (Wh kg^{-1}), C (F g^{-1}), ΔV (V), P (W kg^{-1}), and t (s) are energy density, specific capacitance, voltage window (deducting voltage drop), power density, and discharge time, respectively. Notably, the energy density of the whole supercapacitor was calculated using only the data of negative electrode E-MoS_2 on the premise that positive electrode AC is absolutely excessive.

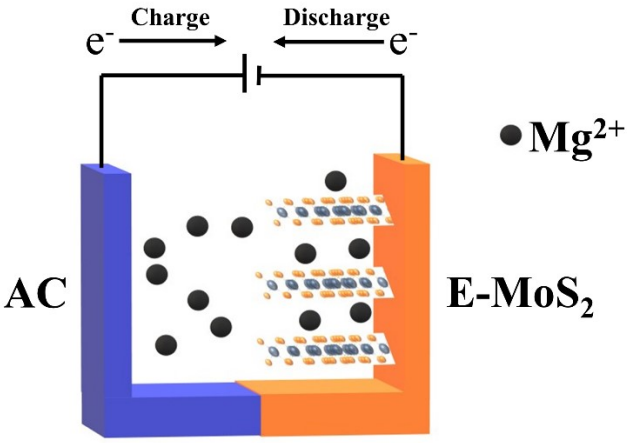

Fig. S1 Schematic diagram of MIS.