Supplementary Material

A facile fabrication of porous $MoSe_2$/carbon microspheres via the aerosol process as anode materials in potassium-ion batter-ies

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This file includes:

- XRD patterns of p-$MoSe_2$@C MS and $MoSe_2$@C MS.
- TG curve of p-$MoSe_2$@C MS.
- Raman spectra of p-$MoSe_2$@C MS.
- CV curves of $MoSe_2$@C MS electrodes.
- Randle-type circuit model.
- The initial galvanostatic charge-discharge curves of p-$MoSe_2$@C MS and $MoSe_2$@C MS electrodes.
- SEM images after 200 cycles of p-$MoSe_2$@C MS and $MoSe_2$@C MS electrodes.

1. *Characterization*

The morphological and structural characteristics of the synthesized composites were investigated by field emission scanning electron microscopy (FE-SEM, using a HITACHI S-4300) and field emission transmission electron microscopy (FE-TEM, using a JEM-2100F, at the Korea Basic Science Institute in Daegu). Powder X-ray diffraction (XRD) patterns were recorded with an X'Pert PRO diffractometer using Cu-Kα radiation (wavelength = 1.5418 Å) at the same institute in Daegu. The carbon content in the composites was quantified using a Pyris 1 thermogravimetric (TG) analyzer (Perkin Elmer), which operates over a temperature spectrum of 25-700 ℃ at a heating rate of 10 ℃ per minute in an air environment. In addition, X-ray photoelectron spectroscopy (XPS) was used to determine the chemical composition and oxidation states within the composites using a K-alpha^{+} model equipped with an Al Kα monochromator. Raman spectroscopy (using a Horiba JY HR LabRam800) was used to study the carbon structures in the composites. In addition, the pore sizes and surface areas of the materials were determined using the Brunauer-Emmett-Teller (BET) technique with pure nitrogen gas as the adsorbent.

2. *Electrochemical measurement*

The electrochemical behavior of the p-MoSe2@C MS electrodes was evaluated using a conventional 2032-type coin cell setup. To prepare the KIB anodes, the active material was combined with carbon black (Super P) and carboxymethyl cellulose (CMC) in a weight ratio of 7:2:1 in deionized water. This mixture was then spread evenly over a copper foil. The coin cell assembly was performed in a controlled environment in a glove box. It consisted of potassium metal as the counter electrode, a glass filter as the separator, and a 3 M solution of potassium bis(fluorosulfonyl)imide (KFSI) in anhydrous diethylene glycol dimethyl ether as the electrolyte. Charge and discharge characteristics and cyclic voltammetry (CV) tests were performed on a battery analyzer (WonATech, WBCS3000L) operating over a voltage range of 0.01-3.0 V at various current densities. In addition, electrochemical impedance spectroscopy (EIS) measurements were performed on the coin cells over a frequency range of 0.1-100 kHz.

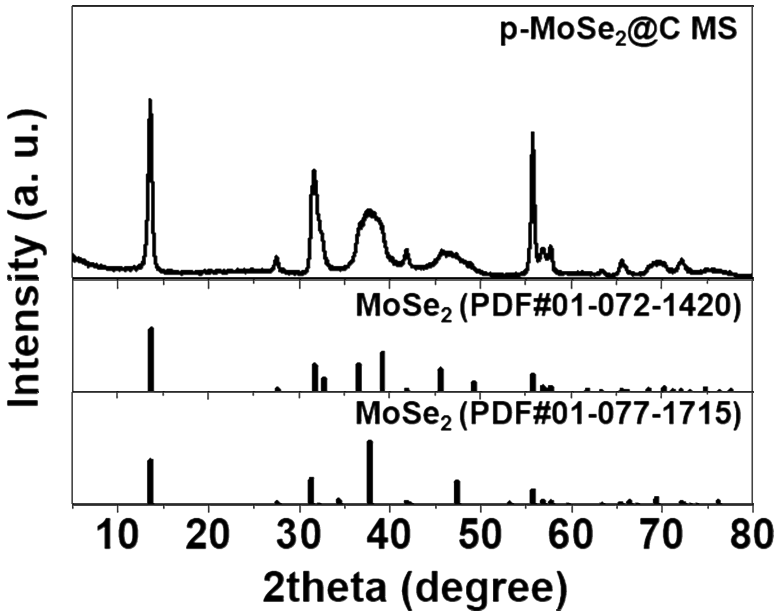

Figure S1. XRD patterns of p-$MoSe_2$@C MS and $MoSe_2$@C MS.

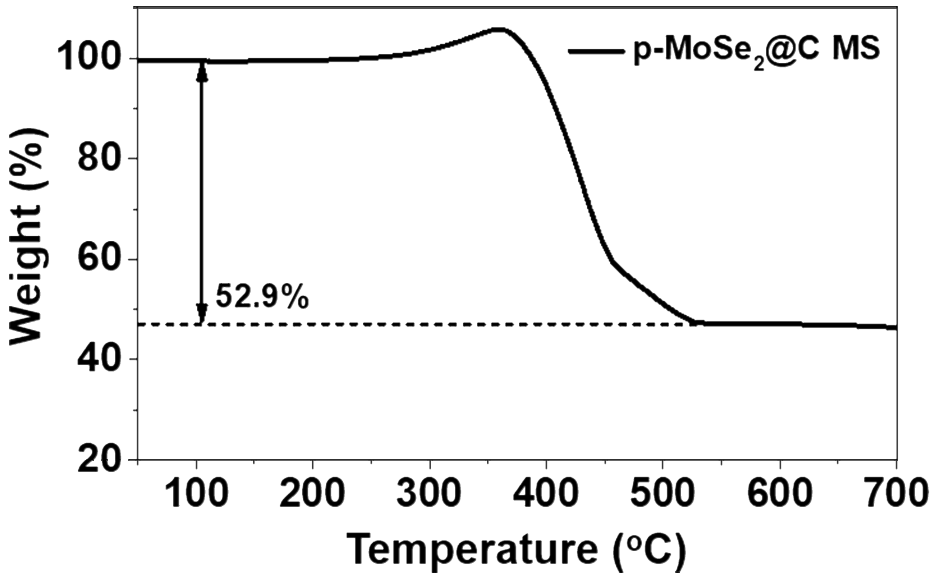

Figure S2. TG curve of p-$MoSe_2$@C MS.

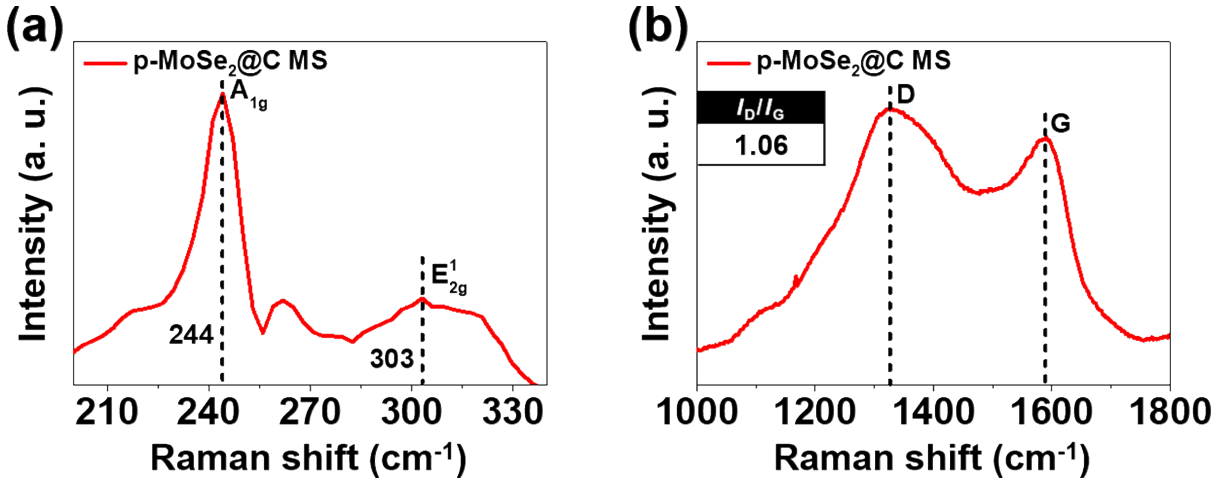

Figure S3. Raman spectra of p-MoSe2@C MS.

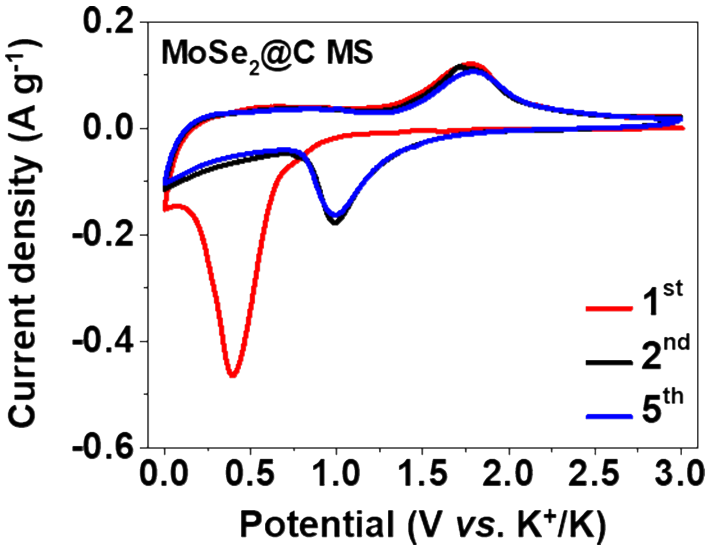

Figure S4. CV curves of $MoSe_2$@C MS electrodes.

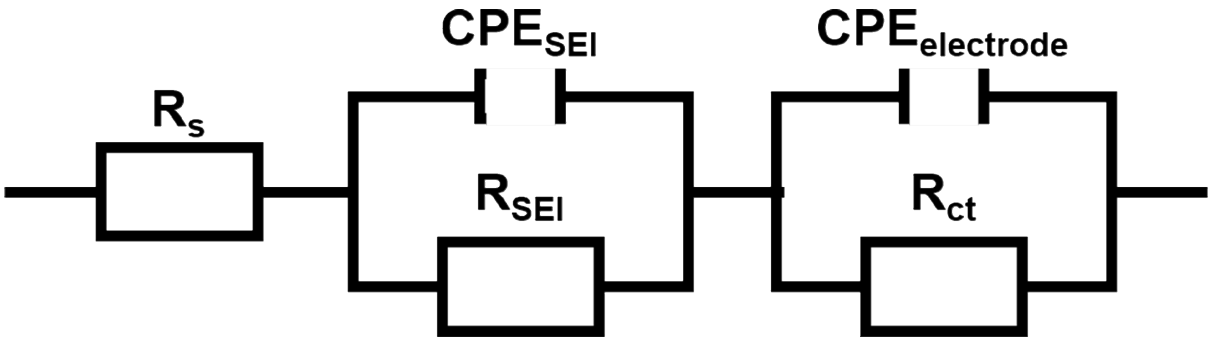

Figure S5. Randle-type circuit model.

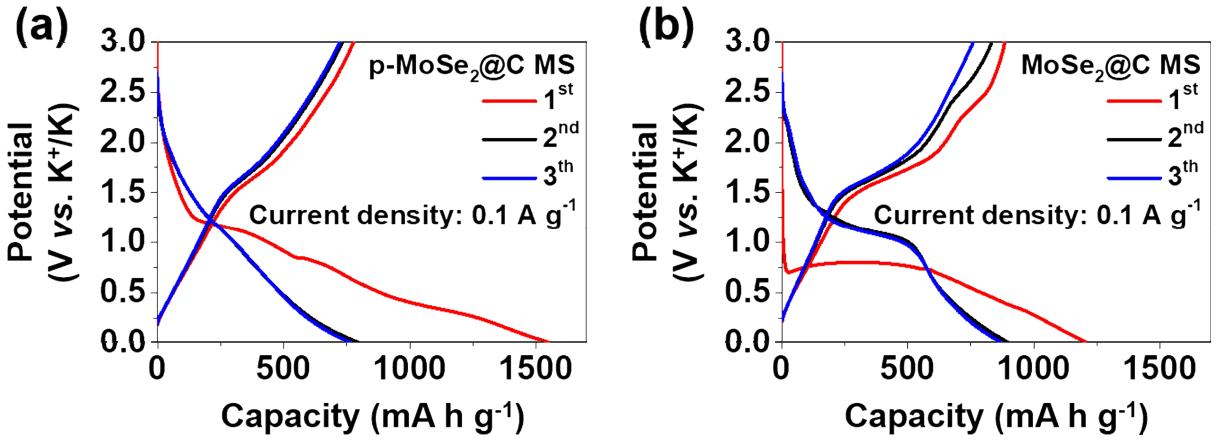

Figure S6. The initial galvanostatic charge-discharge curves of p-$MoSe_2$@C MS and $MoSe_2$@C MS electrodes.

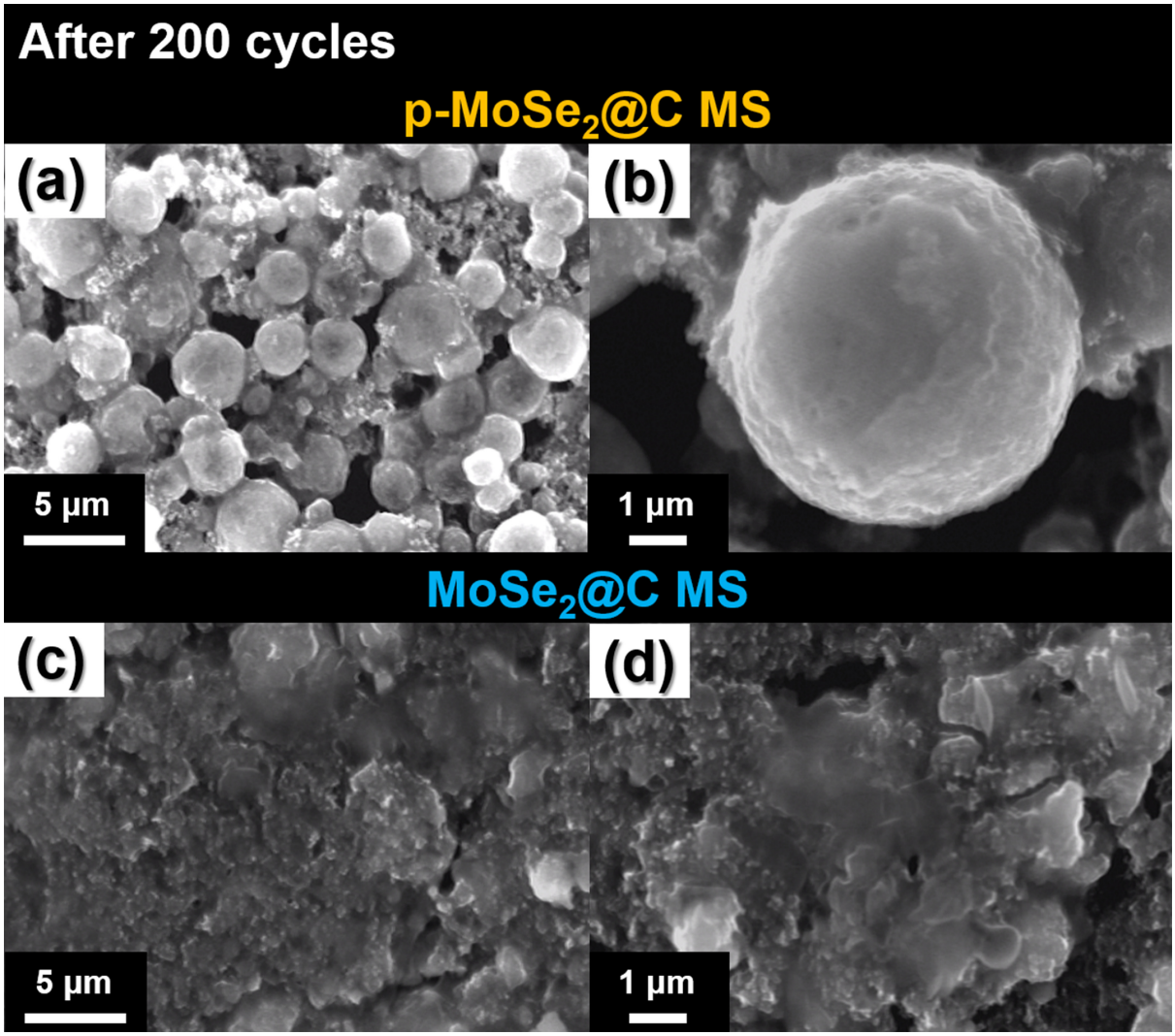

Figure S7. SEM images after 200 cycles of p-$MoSe_2$@C MS and $MoSe_2$@C MS electrodes.

Table S1. Electrochemical properties of various nanostructured Mo-based anode materials for potassium-ion batteries reported in the previous literatures.

Sample	Synthesis method	Voltage window [V]	Current density [mA g^{-1}]	Discharge capacity [mA h g^{-1}] (Cycle)	Ref.
p-$MoSe_2$@C MS	**Spray-drying method**	**0.01-3.0**	**500**	**300 (300^{th})**	**Our work**
$MoSe_2$/C-700	Electrospinning	0.01-3.0	100	316 (100^{th})	**[S1]**
$MoSe_2$/N–C-2	Biomass adsorption method	0.01-3.0	100	240 (100^{th})	**[S2]**
2H-MoS_2/CNC	Grinding-promoted intercalated exfoliation	0.01-2.5	200	203 (300^{th})	**[S3]**
$MoSe_2$@NCNT	Hydrothermal method	0.01-3.0	100	247 (100^{th})	**[S4]**
$MoSe_2$⊂PNC-HNTs	low-temperature solution-phase method	0.01-3.0	100	260 (200^{th})	**[S5]**
MoS_2@C	Three-roll milling	0.01-3.0	500	241 (100^{th})	**[S6]**

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