Supporting Information

Vertically Oriented Growth of MoO_3 Nanosheets on Graphene for Superior Lithium Storage

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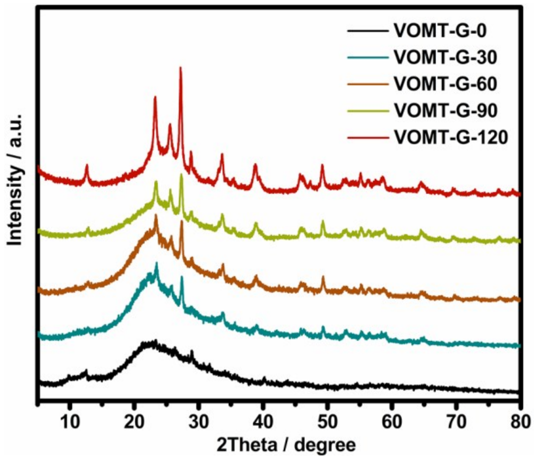

Fig. S1. XRD patterns of VOMT-G-X, (X=0, 30, 60, 90 and 120 min), showing the crystallization process of VOMT-G-X hybrid during annealing treatment.

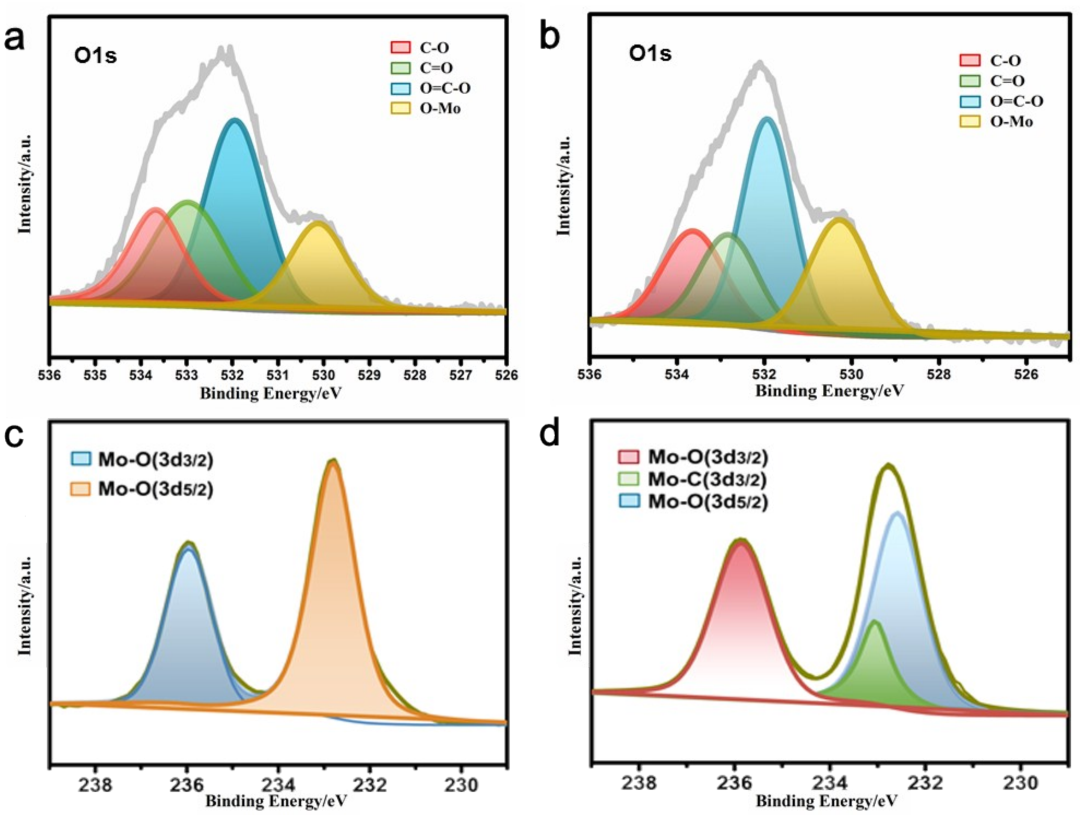

Fig. S2. (a) High-resolution O1s XPS spectra of VOMT-G-0 (without annealing treatment). (b) High-resolution O1s XPS spectra of VOMT-G-90. High-resolution Mo3d XPS spectra of (c) VOMT-G-30 and (d) VOMT-G-60.

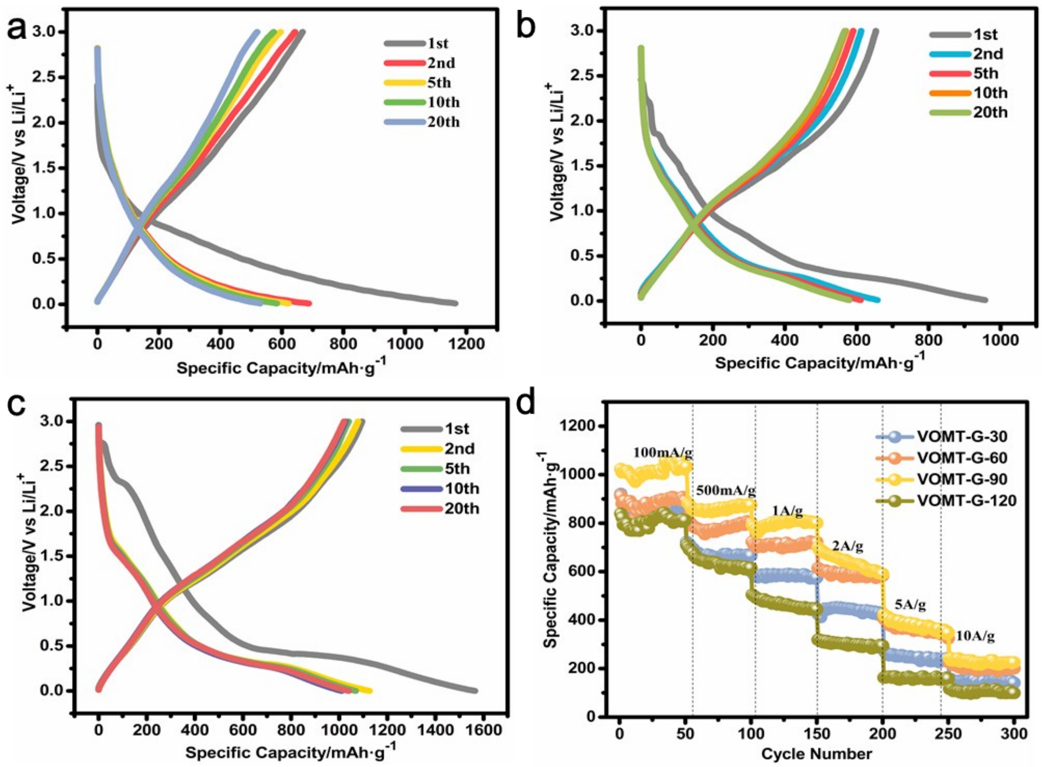

Fig. S3. (a) Charge and discharge curves of GO annealed at 400 °C for 90 min at 100 mA g^{-1}. (b) Charge and discharge curves of VOMT-G-90 annealed at 600 °C, at 100 mA g^{-1}. (c) Charge and discharge curves of VOMT-G-90 at 100 mA g^{-1} and (d) rate capacities of VOMT-G-X (X=30, 60, 90 and 120 min), measured at various rates from 50 to 10000 mA g^{-1}.

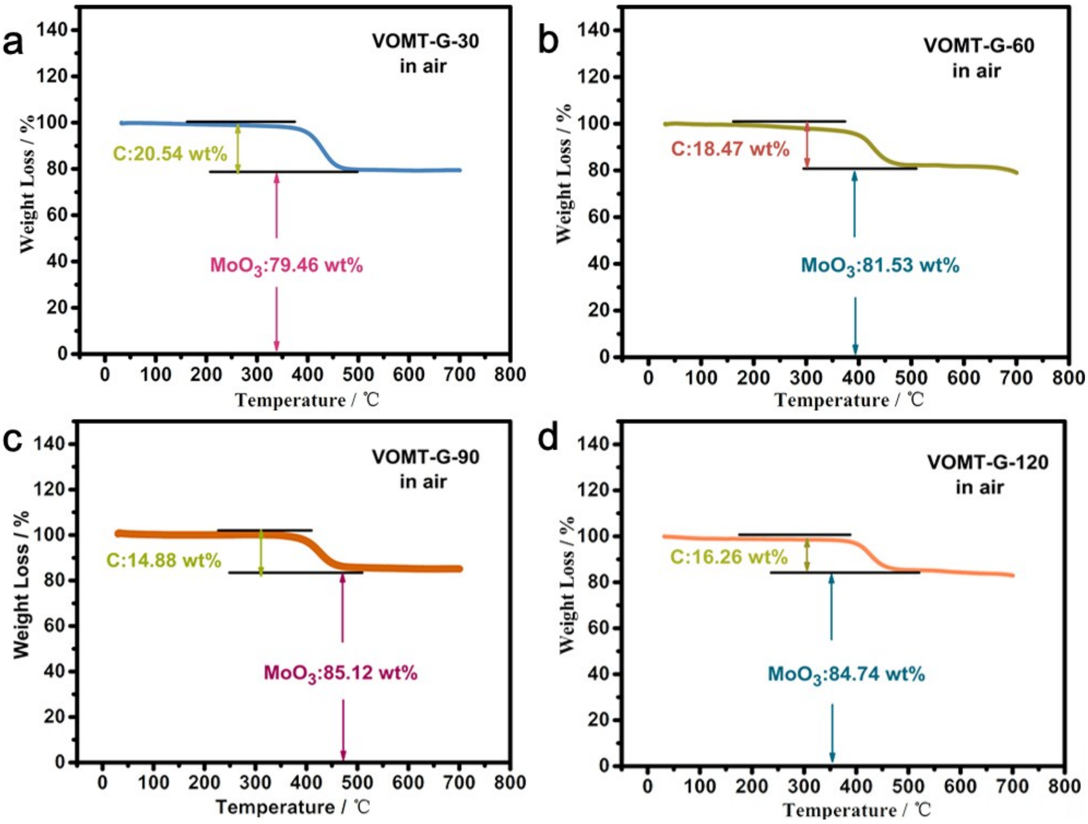

Fig. S4. Thermogravimetric Analysis (TGA) of VOMT-G-X (X=30, 60, 90 and 120 min)

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TABLE S1. Comparison of electrochemical performance between VOMT-G-90 (our work) which has removed the capacity contribution of graphene and other previous works about MoO_3 anodes in lithium ion batteries.

	Specific Capacity ($mAh\ g^{-1}$)	Current density ($mA\ g^{-1}$)	Cycling times
VOMT-G-90 (the current work)	1429.6	50	30
Binder-free MoO_3 nanobelts (Ref.26)	880	100	20
Porous MoO_3 film (Ref.40)	803	70	50
Hexagonal MoO_3 nanorods (Ref.41)	780	150	150
MoO3 Nanowire (Ref.35)	712.2	500	100
Lamellar α-MoO_3 (Ref.37)	1027	0.2 C	50
MoO_3 nanoparticles (Ref.42)	630	0.5 C	150

The capacity contribution of graphene in VOMT-G-90 is calculated by the following equation as:

Capacity contribution of graphene = Capacity of graphene X Weight percentage of graphene.

After subtraction the capacity contribution of graphene from the total capacity, the capacity of MoO3 in VOMT-G-90 was calculated to 1429.6 mAh g-1.

TABLE S2. Comparison of electrochemical performance between VOMT-G-90 (our work) and other previous works about MoO_3/graphene anodes in lithium ion batteries.

	Specific Capacity ($mAh\ g^{-1}$)	Current density ($mA\ g^{-1}$)	Cycling times
VOMT-G-90 (the current work)	1429.6	50	30
In situ synthesis of α-MoO3/graphene composites (Ref.38)	977.7	50	1
MoO3-Reduced Graphene Oxide Powders (Ref.16)	1115	500	100
Reduced Graphene Oxide-Wrapped MoO3 Composites (Ref.15)	779.9	150	30

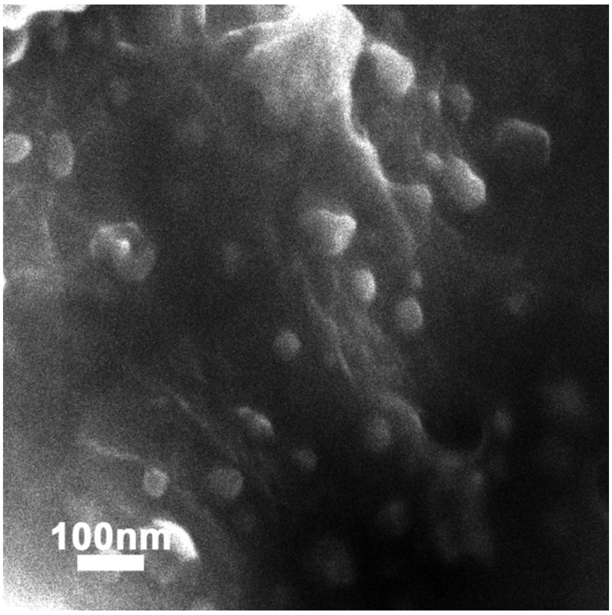

Fig. S5. SEM image of VOMT-G-90 after long term cycling.

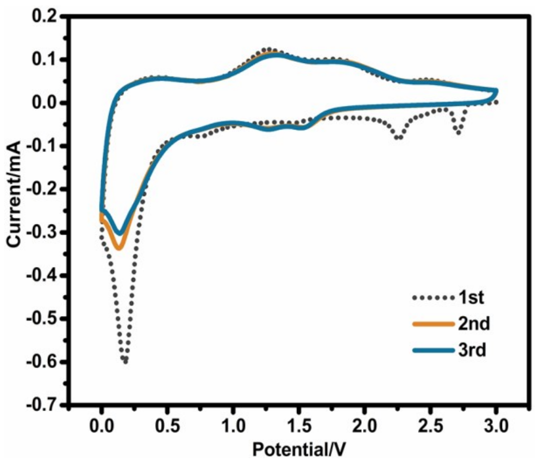

Fig. S6. Cyclic voltammogram (CV) curves of VOMT-G-90 in a half cell at a scan rate of 0.1 mV s^{-1} ranged in 0.01–3.0 V vs. Li/Li^+.

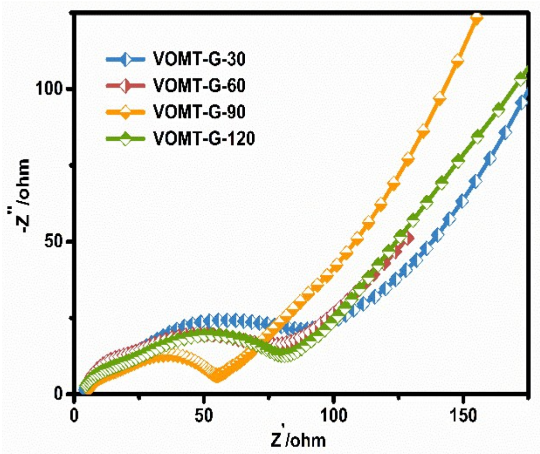

Fig. S7. Nyquist plots of VOMT-G-X, (X=30, 60, 90, and 120 min) after rate cycles.

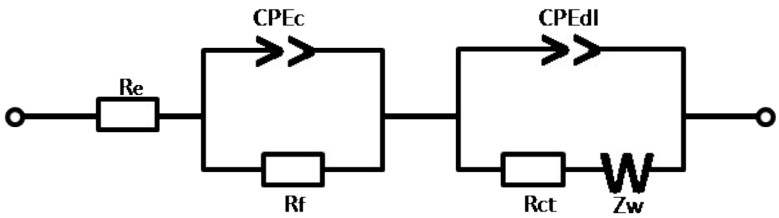

Fig. S8. Equivalent circuit model for EIS analysis.

Table S3. Simulation results of the kinetic parameters of VOMT-G-X. (X=30, 60, 90 and 120 min) for lithium storage.

Sample	R_e (Ω)	R_f (Ω)	R_{ct} (Ω)
VOMT-G-30	3.8	12.33	54.31
VOMT-G-60	4.2	13.98	41.8
VOMT-G-90	3.8	10.1	38.32
VOMT-G-120	3.2	13.11	66.57

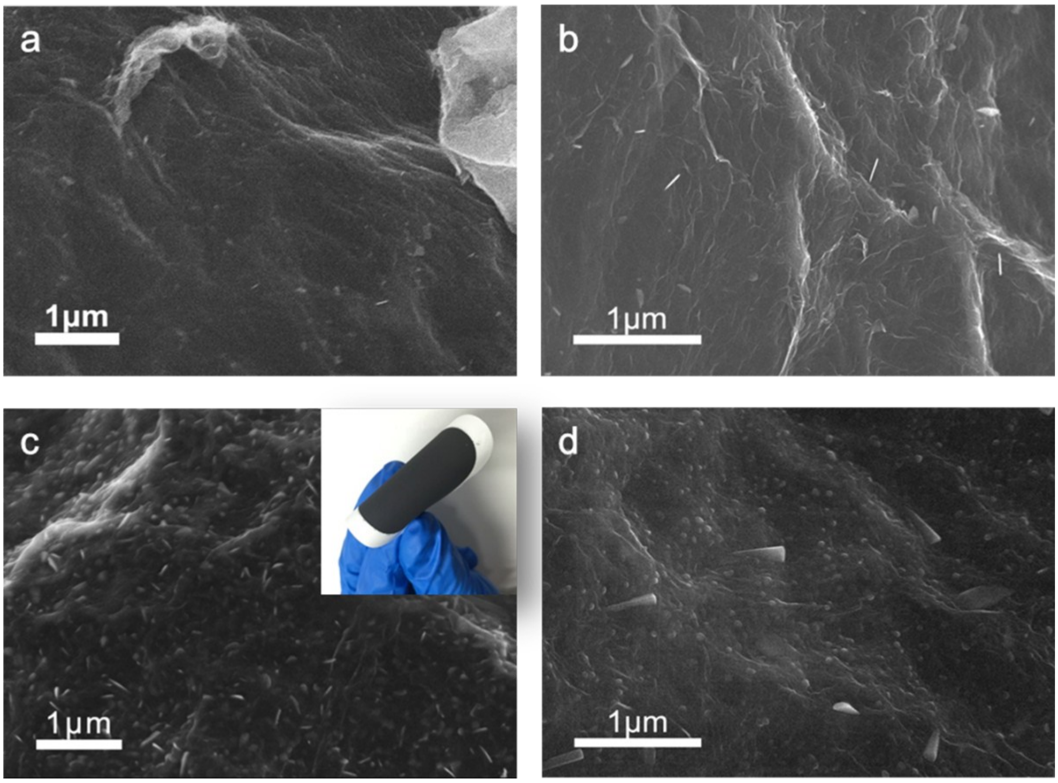

Fig. S9. SEM images of (a) VOMT-G-30, (b) VOMT-G-60, (c) VOMT-G-90, and (d) VOMT-G-120. The insert in (c) shows an optical graph of VOMT-G-90 film.

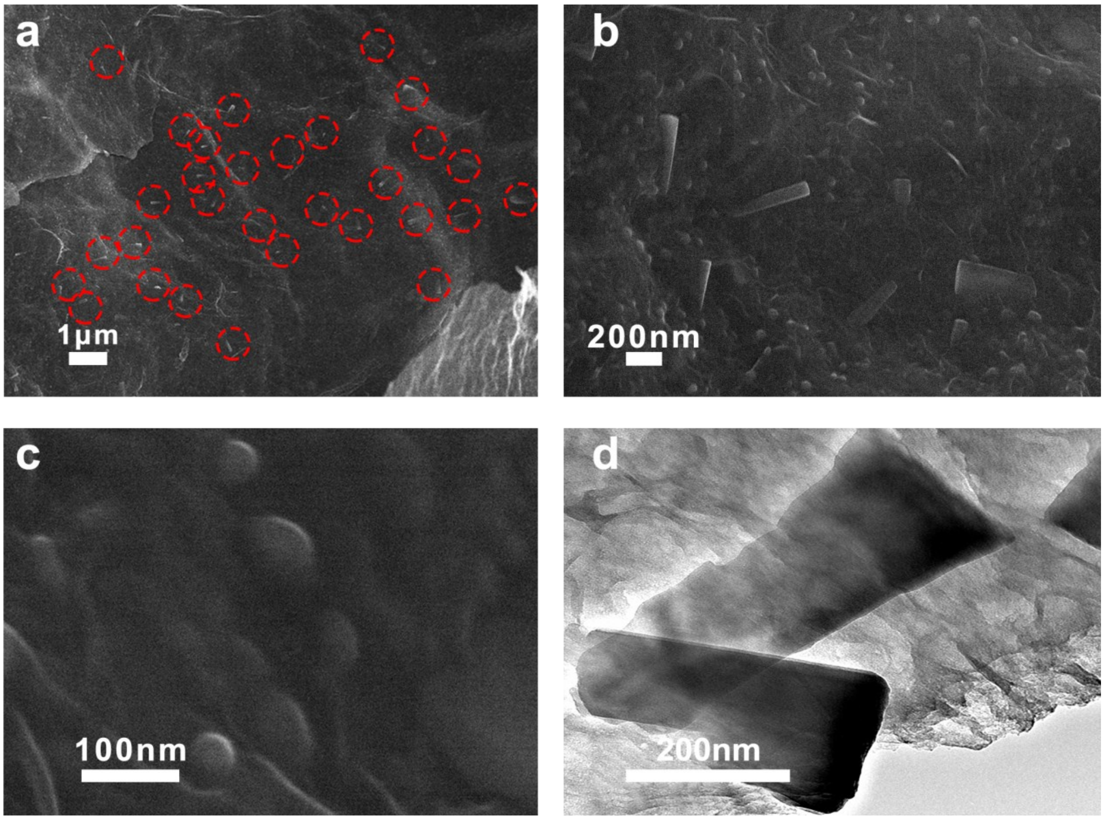

Fig. S10 SEM images of VOMT-G-120 (a) a number of MoO_3 nanoflakes can be seen even at a very low magnification at 5K, showing its large size, and it was indicated by the red circles. And (b) demonstrating the proportion of the overgrowth MoO_3 nanoflakes. (c) High resolution SEM image of VOMT-G-120, revealing the vertically oriented MoO_3 nanosheets still exist. (d) TEM images of VOMT-G-120, showing some overgrowth MoO_3 nanosheets.