Supporting Information:

**VO₂(p)-V₂C(MXene) Grid Structure as a Lithium Polysulfide Catalytic Host for High-performance Li-S Battery**

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Fig. S1 (a and b) The multilayer V$_2$C treated with TMAOH for 6 h.
Fig. S2 The pure VO$_2$(p) nanorod clusters hydrothermally grown and annealed at 120°C.
Fig. S3 Schematic diagram of crystal structure along different VO$_2$(p) crystal orientations. (a) The primitive unit cell of VO$_2$(p). (b) The extended unit cell of VO$_2$(p). (c) The (111) orientation of VO$_2$(p). (d) The (001) orientation of VO$_2$(p).
Fig. S4 Schematic diagram of crystal structure along different crystal orientations. 
(a) The primitive unit cell of $V_2AlC$. (b) The extended unit cell of $V_2AlC$. (c) The (001) orientation of $V_2CO_2$. (d) The (110) orientation of $V_2CO_2$. 
Fig. S5 (a) N$_2$ adsorption-desorption of V$_2$C nanosheets. (b) Pore diameter analysis of VO$_2$. 
Fig. S6 The XPS full spectrum of VO$_2$(p)-V$_3$C.
Fig. S7 discharge/charge voltage curves of rate performance for (a) VO$_2$(p)-V$_2$C/S and (b) V$_2$C/S cathode.
Fig. S8 (a)-(d) FESEM images of VO$_2$(p)-V$_2$C/S cathodes after 500 cycles with different magnifications, showing the high structural integrity of VO$_2$(p)-V$_2$C host.
Fig. S9 (a-d) Film formation performance and flexible features of the as-synthesized VO$_2$(p)-V$_2$C host.
Fig. S10 (a) and (b) the photograph of soft package Li-S lighting a 2.4-inch LCD screen driven by a single chip microcomputer for more than 30 h.
Fig. S11 The three-electrode split cell system used in electrochemical measurement.
Fig. S12 cyclic voltammetry curves of (a) V₂C/S and (b) VO₂(p)-V₂C/S cathodes at the scan rate of 0.1 mV·s⁻¹.
Fig. S13 sealed vials of different LiPSs solutions, V$_2$C-LiPSs solutions and VO$_2$(p)-V$_2$C-LiPSs solutions for 30 min and 8 h.
Fig. S14 photographs showing separators of cells with (a) V$_2$C/S and (b) VO$_2$(p) -V$_2$C/S cathodes disassembled after 200 cycles at a current density of 2 C.
Fig. S15 Electrochemical impedance spectra of the symmetric cells.
Fig. S16 (a) The interfaces of VO$_2$(p)-V$_2$C bilayer structural model. (b) The charge density difference graph of (110) VO$_2$(p)-V$_2$C. The green and yellow regions represent the space charge accumulation and charge depletion region, respectively.
Fig. S17 The most favorable adsorption configuration of $S_8$, $Li_2S$, $Li_2S_2$, $Li_2S_4$, $Li_3S_6$ and $Li_2S_8$ on monolayer $V_2CO_2$. Optimized structure of potential adsorption configurations were showing in (a) to (f).
Fig. S18 The most favorable adsorption configuration of $S_8$, Li$_2$S, Li$_2$S$_2$, Li$_2$S$_4$, Li$_2$S$_6$ and Li$_2$S$_8$ on VO$_2$(p)-V$_2$CO$_2$. Optimized structure of potential adsorption configurations were showing in (a) to (f).
Table S1 The comparison of sulfur loading capacity and area capacity performance of cathode materials for vanadium-based two-dimensional lithium-sulfur batteries.

<table>
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<tr>
<th>Cathode materials</th>
<th>S loading (mg cm(^{-2}))</th>
<th>Current density (C)</th>
<th>Cycles</th>
<th>Initial capacity (mAh g(^{-1}))</th>
<th>Areal capacity (mAh cm(^{-2}))</th>
<th>Capacity decay (% per cycle)</th>
<th>Year</th>
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<td>10.2</td>
<td>0.2</td>
<td>200</td>
<td>1025</td>
<td>9.3</td>
<td>0.15</td>
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<td>0.2</td>
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<td>0.5</td>
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<td>~950</td>
<td>1.14-1.4</td>
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<td>1.2-1.5</td>
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Reference


