Supporting Information

Anomalous oxidation and its effect on electrical transport originating from surface chemical instability in large area, few-layer 1T'-MoTe$_2$ film

Li Yang, Hao Wu, Wenfeng Zhang, Zhenhua Chen, Jie Li, Xun Lou, Zijian Xie, Rui Zhu and Haixin Chang*

L. Yang, H. Wu, Prof. Dr. W. Zhang, J. Li, X. Lou, Z. Xie, R. Zhu and Prof. Dr. H. Chang Center for Joining and Electronic Packaging, State Key Laboratory of Material Processing and Die & Mould Technology, School of Materials Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, PRC. Shenzhen R&D Center of Huazhong University of Science and Technology, Shenzhen 518000, PRC. E-mail: wfzhang@hust.edu.cn, hxchang@hust.edu.cn

Prof. Dr. Z. Chen, Shanghai Synchrotron Radiation Facility, Shanghai Institute of Applied Physics, Chinese Academy of Science, Shanghai 201204, PRC.

*Theses authors contributed equally to this work.
Figure S1. (a) Raman spectral evolution of the pristine and thermally processed few-layer 1T'-MoTe₂ films at the different elevated temperatures with the constant N₂ flow rate (50 sccm) for 30 min, respectively. (b) the corresponding intensity ratio of peak A (~123 cm⁻¹), B (~143 cm⁻¹) and B₉ (~161 cm⁻¹) to the silicon Raman mode plotted as a function of process temperature.
Figure S2. Raman spectral evolution of the pristine and thermal processed few-layer 1T'-MoTe$_2$ films at the different elevated temperatures by using the different O$_2$ gas flow rates (varying between 0, 10, 20, 30, and 50 sccm) diluted with a constant flow rates (50 sccm) of N$_2$ gas for 30 min at 250 °C (a) and 320 °C (b), respectively.
Figure S3. Typical temperature-dependent transport measurements of few-layer 1T′-MoTe₂ films after the different thermal treatments. (a) O₂ treatment with a constant flow rate (50 sccm) at 100 °C for 30 minutes. (b) O₂ treatment with a constant flow rate (50 sccm) at 250 °C for 30 minutes. (c) N₂ treatment with a constant flow rate (50 sccm) at 250 °C for 30 min.
**Table S1.** The full width at half maximum (FWHM) for Bg peak at ~161 cm⁻¹ of few-layer 1T'-MoTe₂ before and after the different thermal treatments from the Raman phonon band analysis.

<table>
<thead>
<tr>
<th>Different thermal treatments</th>
<th>Pristine 1T'-MoTe₂</th>
<th>Ambient conditions (several days)</th>
<th>100 °C 50 sccm O₂</th>
<th>250 °C 50 sccm O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>FWHM (cm⁻¹)</td>
<td>4.226</td>
<td>4.398</td>
<td>4.413</td>
<td>4.404</td>
</tr>
</tbody>
</table>