Supplementary Information:

**Controllable 2H-to-1T’ phase transition in few-layer MoTe$_2$**

Yuan Tan$^{1*}$, Fang Luo$^{2*}$, Mengjian Zhu$^{2*}$, Xiaolong Xu$^{3,4}$, Yu Ye$^{3,4}$, Bing Li$^{5}$, Guang Wang$^{1}$, Wei Luo$^{1}$, Xiaoming Zheng$^{6}$, Nannan Wu$^{1}$, Yayun Yu$^{1}$, Shiqiao Qin$^{2}$, Xue-Ao Zhang$^{1*}$

1 College of Arts and Science, National University of Defense Technology, Changsha, 410073, China
2 College of Advanced Interdisciplinary Studies, National University of Defense Technology, Changsha, 410073, China
3 State Key Lab for Artificial Microstructure & Mesoscopic Physics, School of Physics, Peking University, Beijing, 100871, China
4 Collaborative Innovation Center of Quantum Matter, Beijing 100871, China.
5 College of Aerospace Science, National University of Defense Technology, Changsha, 410073, China
6 Hunan Key Laboratory of Super-microstructure and Ultrafast Process, College of Physics and Electronics, Central South University, Changsha, 410083, China

* Corresponding authors: E-mail: mengjian.zhu@outlook.com; xazhang@nudt.edu.cn
# These authors contributed equally to this work

Figure S1. Characterizations of a few-layer MoTe$_2$ before laser irradiation and after laser irradiation

Figure S2. The stability of laser-induced 1T’-MoTe$_2$

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Figure S4. Raman spectra of few-layer 2H-MoTe$_2$ and 1T’-MoTe$_2$

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Figure S7. Te treatment of laser-induced 1T’-MoTe$_2$

Figure S8. Probing of the absence of oxide on the surface of a few-layer MoTe$_2$ after laser irradiation
Figure S1. Characterizations of a few-layer MoTe₂ before laser irradiation and after laser irradiation. a-c, Optical microscopic image, AFM image and Raman mapping of 2H-MoTe₂. The scale bar is 2 μm. The Raman mapping is defined by 2H-MoTe₂ Raman peak at 235 cm⁻¹ with peak width of 20 cm⁻¹; d-f, Optical microscopic image, AFM image and Raman mapping of laser-patterned 2H-MoTe₂ with 1T'-MoTe₂ on the top (laser power: 10 mW) and bottom areas (laser power: 10 mW). The laser irradiation time was 10 mins with 0.2 s per point. The Raman mapping is defined by 1T'-MoTe₂ Raman peak at 125 cm⁻¹ with peak width of 20 cm⁻¹.
Figure S2. The stability of laser-induced 1T'-MoTe$_2$. 

**a**, Optical microscopic image of a laser-patterned few-layer MoTe$_2$. The scale bar is 3 $\mu$m; 
**b**, Optical microscopic image of a laser-patterned few-layer MoTe$_2$ after 8 days in ambient conditions; 
**c,d**, Raman mapping of MoTe$_2$ after 8 days defined by 125 cm$^{-1}$ (1T' phase) and 235 cm$^{-1}$ (2H phase) with spectra width of 20 cm$^{-1}$; 
**e,f**, Raman spectra of 1T'-MoTe$_2$ and 2H-MoTe$_2$ before and after 8 days in ambient conditions, demonstrating no obvious decay in both 1T' and 2H phase MoTe$_2$. 
Figure S3. Laser thinning effect in MoTe$_2$ under different irradiation conditions. a,b, Raman spectra of a few-layer MoTe$_2$ after laser irradiation with various laser power and irradiation time, respectively. The Raman signals of silicon (~520 cm$^{-1}$) gradually increase as the applied laser power and irradiation time, indicating enhanced laser thinning effect in a few-layer MoTe$_2$.

Figure S4. Raman spectra of few-layer 2H-MoTe$_2$ and 1T'-MoTe$_2$
Figure S5. The correlation of laser power and phase transition in a few-layer MoTe$_2$.

a, Optical microscopic image of a laser-patterned few-layer MoTe$_2$. The inset is the flake thickness (~8nm) determined by AFM. The applied laser power of each square is marked by the white numbers with unit of mW. b,c, Raman mapping of patterned MoTe$_2$ defined by two characteristic peaks at 235 cm$^{-1}$ (2H-MoTe$_2$) and 125 cm$^{-1}$ (1T'-MoTe$_2$), respectively. d,e, Raman spectra of MoTe$_2$ and Si after laser patterning, respectively.
Figure S6. EDX analysis of MoTe$_2$. a, Laser-patterned few-layer MoTe$_2$ sample with thickness of ~8 nm. The scale bar is 10 μm; The red and blue squares mark the positions for EDX spectrums; b,c, Raman mapping of 1T’ phase and 2H phase of MoTe$_2$ defined by 125 cm$^{-1}$ and 235 cm$^{-1}$, respectively; d,e, Typical EDX spectrums of 1T’ phase and 2H phase of MoTe$_2$ taken from Figure S6a; f,g, The measured percentage of concentration of Mo and Te elements in 1T’ phase and 2H phase of MoTe$_2$, respectively.
Figure S7. Te treatment of laser-induced 1T'-MoTe$_2$. a-c, optical microcopy and Raman mapping of a few-layer 1T'-MoTe$_2$ induced by laser irradiation. The Raman mapping are defined by two peaks at 125 cm$^{-1}$ (1T' phase) and 235 cm$^{-1}$ (2H phase), respectively. The scale bar is 3 μm; d-f, characterizations of 1T'-MoTe$_2$ after Te treatment at 650 °C, showing no signature of reverse 1T'-to-2H phase transition.
Figure S8. Probing of the absence of oxide on the surface of a few-layer MoTe$_2$ after laser irradiation. a-c, Optical microscopic image and Raman mapping of laser irradiated MoTe$_2$. The scale bar is 2 μm. Raman mapping are defined by two peaks at 125 cm$^{-1}$ (1T' phase) and 235 cm$^{-1}$ (2H phase), respectively; d, Raman spectra taken from A and C area before laser irradiation and after. The vertical dashed line indicates the possible peak position of MoO$_3$ at 820 cm$^{-1}$; e, Raman mapping of MoTe$_2$ after phase patterning defined by the peak at 820 cm$^{-1}$ (MoO$_3$), showing no signature of oxide.