Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Tunable Large-area Phase Reversion in Chemical Vapor Deposited Few-layer $MoTe_2$ Films

Xukun Zhu[a], Aolin Li[a], Di Wu[b], Peng Zhu[a], Haiyan Xiang[c], Song Liu[c], Jian Sun[b], Fangping Ouyang[a, b*], Yu Zhou[b, a*], Xiang Xiong[a*]

[a] Powder Metallurgy Research Institute and State Key Laboratory of Powder Metallurgy, Central South University, Changsha 410083, PR China

[b] School of Physics and Electronics, and Institute of Super-microstructure and Ultrafast Process in Advanced Materials, Central South University, Changsha 410083, PR China

[c] Institute of Chemical Biology and Nanomedicine (ICBN), State Key Laboratory of Chemical/Biosensing and Chemometrics, College of Chemistry and Chemical Engineering, Hunan University, Changsha 410082, PR China

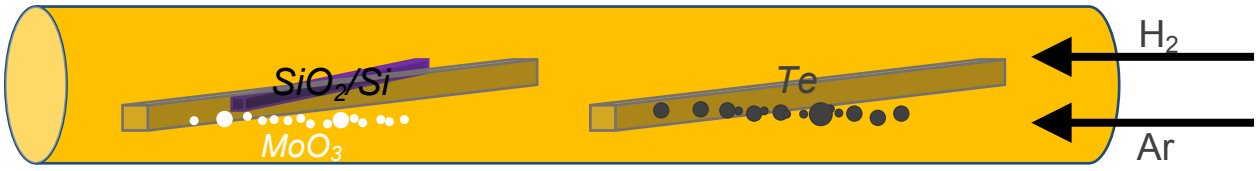

Figure S1. Schematic diagram of the synthesis of $MoTe_2$ thin film by chemical vapor deposition (CVD)

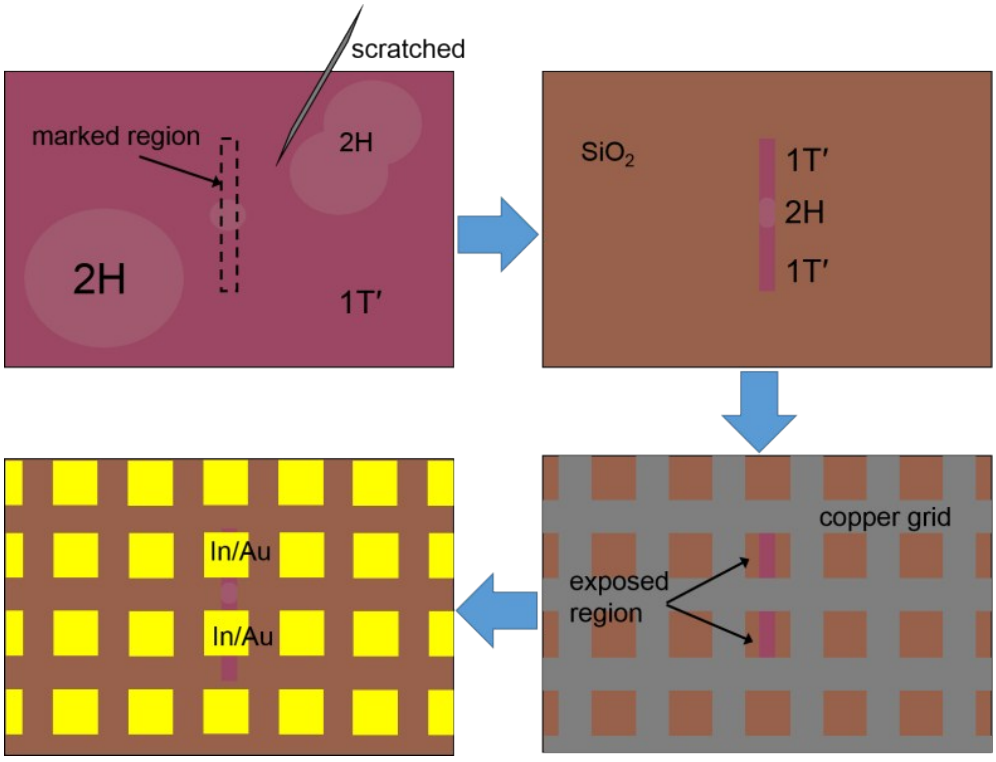

Figure S2. A schematic figures of the fabrication process of 1T'-2H-1T' MoTe2 FET

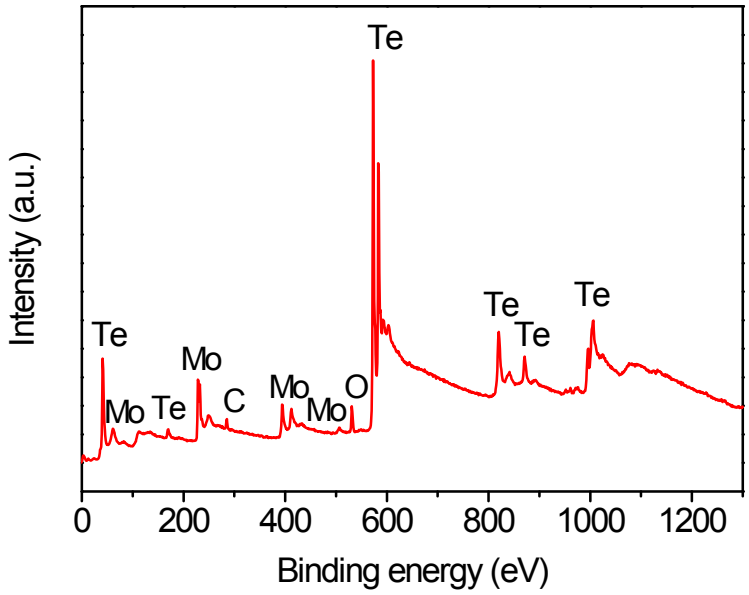

Figure S3. full survey XPS spectra of $MoTe_2$ film

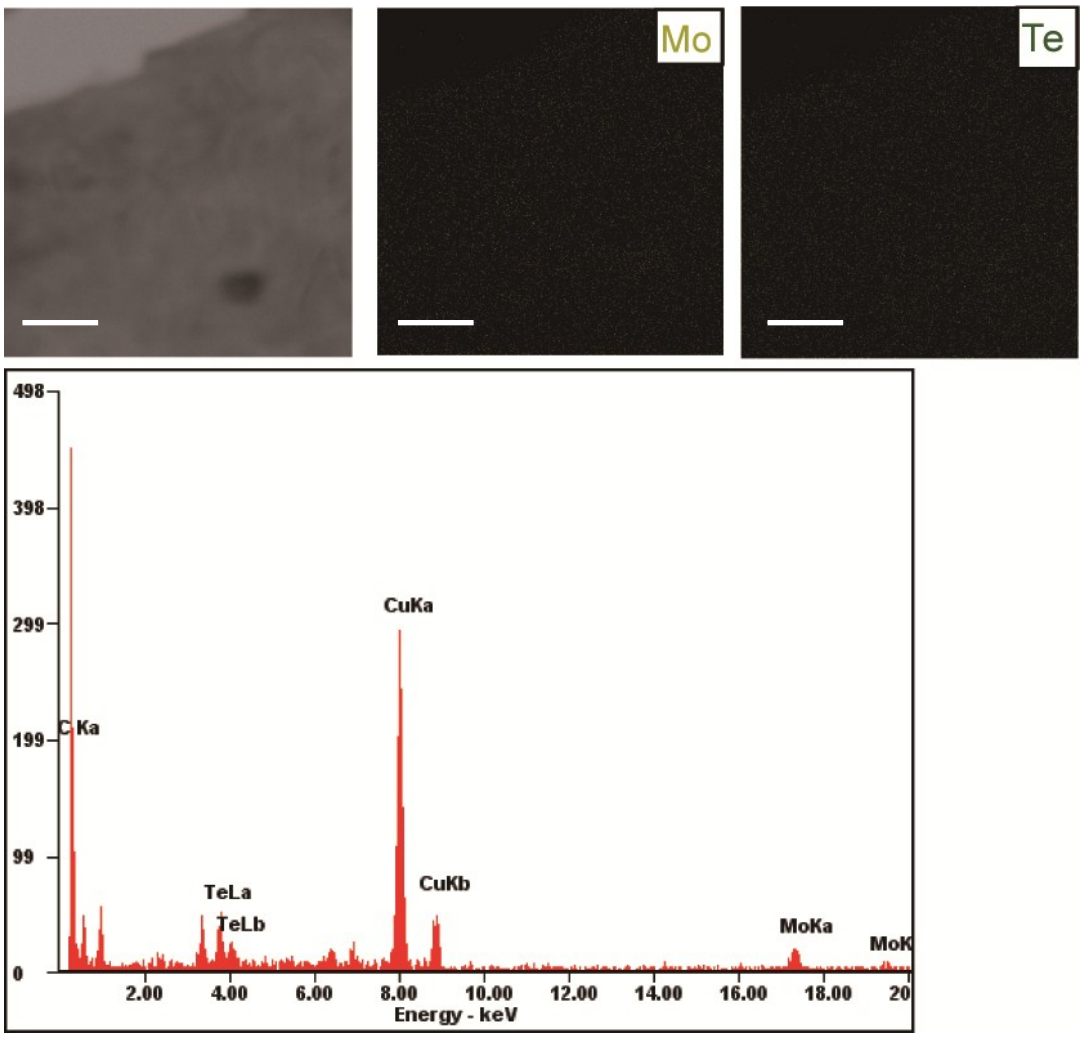

Figure S4. EDX mapping of selected area $MoTe_2$ film (The scale bar is 1 μm).

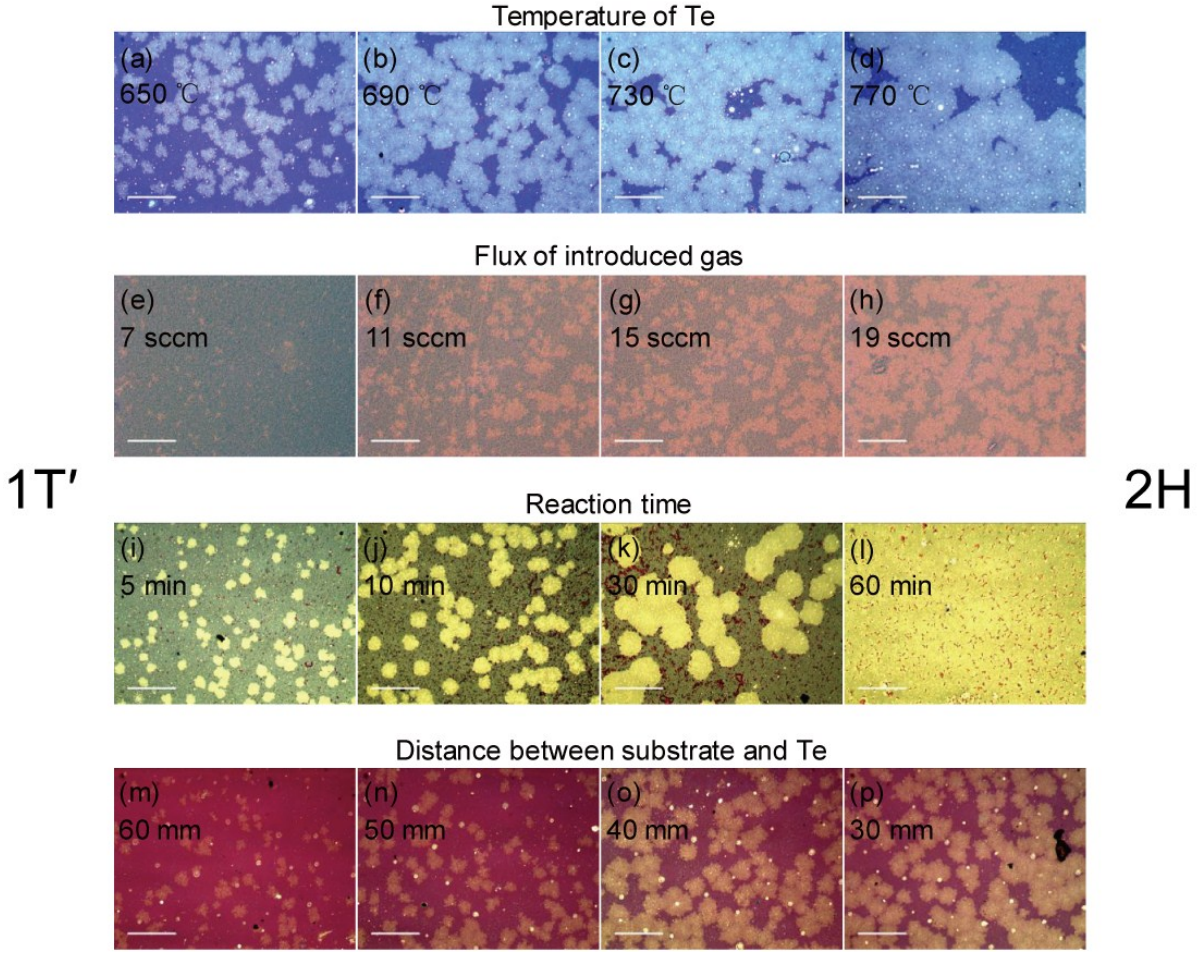

Figure S5. OM images of four methods controlling the 1T′-2H phase transition of CVD-grown $MoTe_2$ film. The scale bar is 100 μm. a-d) At different temperature of Te region (650, 690, 730 and 770 ℃, respectively.). e-h) With different flux of introduced gas (7, 11, 15 and 19 sccm, respectively.). i-l) With different reaction time (5, 10, 30 and 60 min, respectively.). m-p) With different distance between substrate and Te (60, 50, 40 and 30 mm).

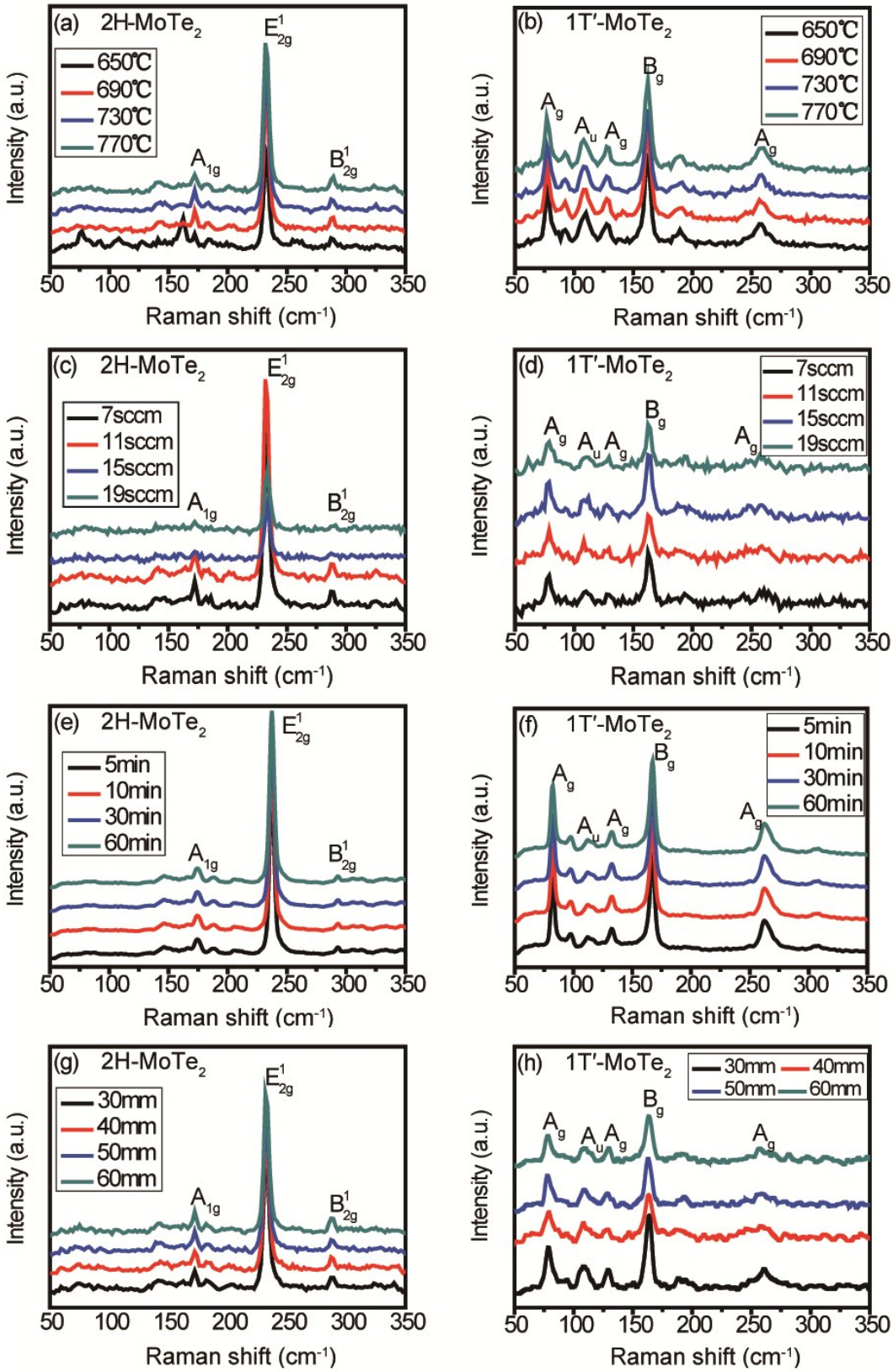

Figure S6. Raman spectra of four methods controlling the 1T′-2H phase transition of CVD-grown $MoTe_2$ film. a-d) At different temperature of Te region (650, 690, 730 and 770℃, respectively.). e-h) With different flux of introduced gas (7, 11, 15 and 19sccm, respectively.). i-l) With different reaction time (5, 10, 30 and 60min, respectively.). m-p) With different

distance between substrate and Te (60, 50, 40 and 30mm).

As seen in Figure S5 a-d are the OM images at different temperature of Te region (650, 690, 730, and 770 ℃, respectively), e-h are the OM images at different total gas-flow rate (7, 11, 15, and 19 sccm, respectively, gas-flow rate of H_2 is always 4 sccm), i-l are the OM images at different reaction time (5, 10, 30, and 60 min, respectively), m-p are the OM images at different distance between the substrate and Te grain (30, 40, 50, and 60 mm, respectively), and in order to distinguish better we choose different visible light filters in OM for these four variables. The Raman spectra were also taken in the bright spot area and dark area of all samples (Figure S6). The Raman spectra of all samples demonstrate the bright spot area which is observed in OM image is 2H-$MoTe_2$, and the other dark area is 1T′-$MoTe_2$. It can be concluded that with the rise of temperature of Te source, the increase of gas flow, the growth of reaction time and the decrease of the distance between the substrate and Te grain, 1T′ phase gradually transforms into 2H phase and vice versa.

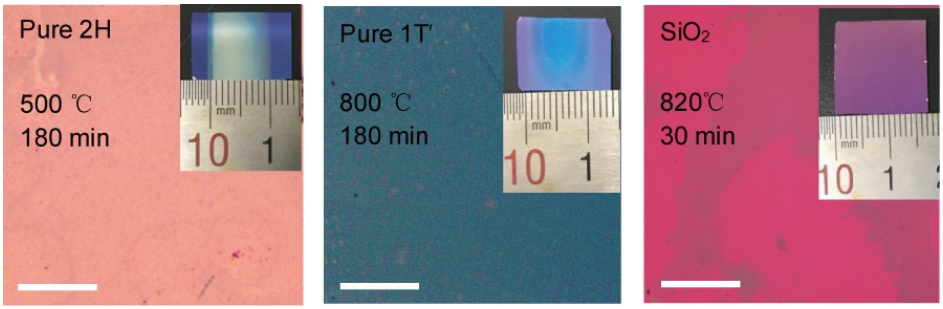

Figure S7. OM images (the scale bar is 50μm) and photos (inset) of pure 2H-$MoTe_2$ at temperature of 500℃ and pure 1T′-$MoTe_2$ at temperature of 800℃ under the holding time of 180 min, and evaporation sample at 820℃.