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Supplementary Information

Effect of microplate size on the semiconductor-metal transition in VO_2 thin films

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1. Room temperature resistivity of VO_2 film devices

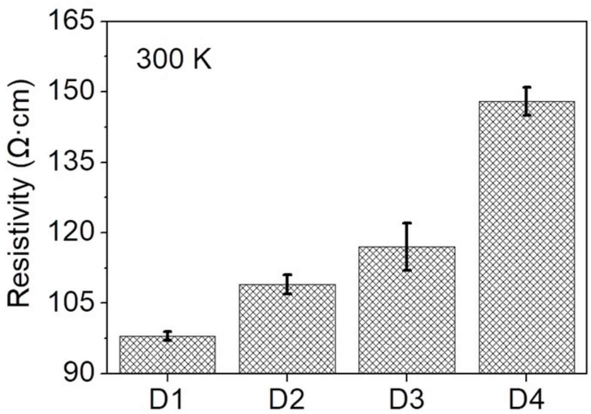

Figure S1. The estimated average resistivity of VO_2 film devices D1 to D4 collected from four devices for each case at room temperature. The results show that the resistivity of VO_2 film devices D4 to D1 reduces as grain boundary density increases, indicating that grain boundaries can lower the electrical resistance of semiconductor states by introducing defect levels between the Fermi level and the conduction band edge in the VO_2 bandgap.

2. The first derivative of the temperature curves

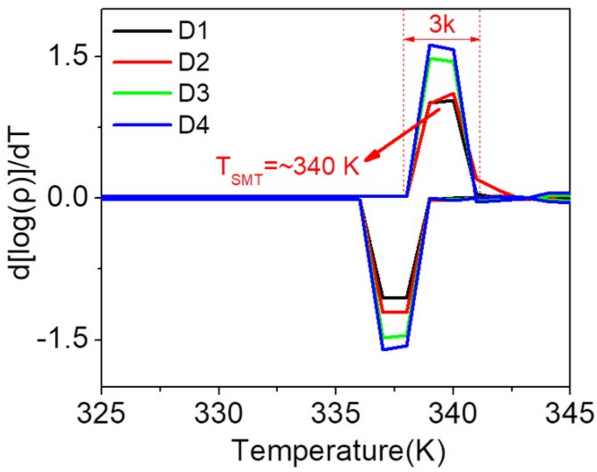

Figure S2. The first derivative of the temperature curves ($|d[\log(\rho)]/dT|$) extracted from Figure 4(a) for a clear view of the T_{SMT} of VO_2 films with different microstructures. The results show that the T_{SMT} (~340 K) is not considerably different during the SMT process for VO_2 thin films with different microstructures.

3. The current variation before and after transition

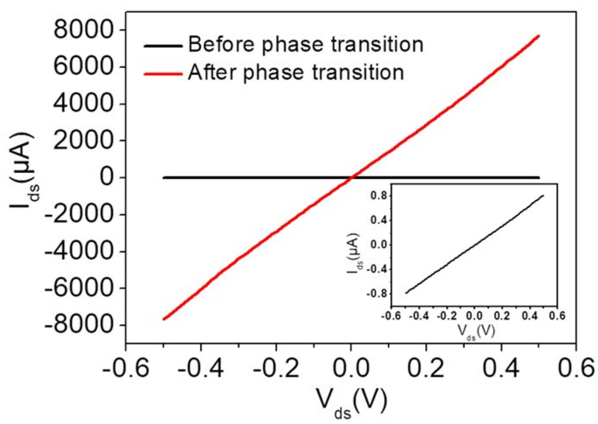

Figure S3. I_{ds}-V_{ds} curves of D4 device measured at 300 K and 350 K, i.e. before and after phase transition. The current variation also changes by more than four orders of magnitude during the SMT process.

4. The morphology and phase transition properties of Mo^{6+}-doped VO_2 film

Doping heterogeneous ions (such as W^{6+}, Mo^{6+}, and Nb^{6+}) is the commonly adopted approach to reduce the T_{SMT}. Here we have further carried out Mo^{6+} doping during the growth of S4 film sample by using MoO_3 powder as doping agent (5 mg). Limited by our own instrument conditions, EDS instead of XPS has been employed to detect elements in the doped film, and confirms the existence of Mo element. The test result shows that the T_{SMT} of doped VO_2 film is lowered to 335 K, as shown in **Figure S4(a)**. Meanwhile, it should be noted that the amplitude of the transition is decreased to 3 decades. However, with increasing the amount of MoO_3 powder, the VO_2 film becomes very discontinuous, making it difficult to fabricate device for phase transition measurements (In fact, the porous structures have appeared in the doped film), as shown in **Figure S4(c) and (d)**. In current work, we emphasize on the effect of microplate size on the semiconductor-metal transition in VO_2 thin films by adjusting the amounts of precursors, more systematic investigations for the modulation of T_{SMT} of VO_2 thin films by heterogeneous ions doping will be studied in the future work.

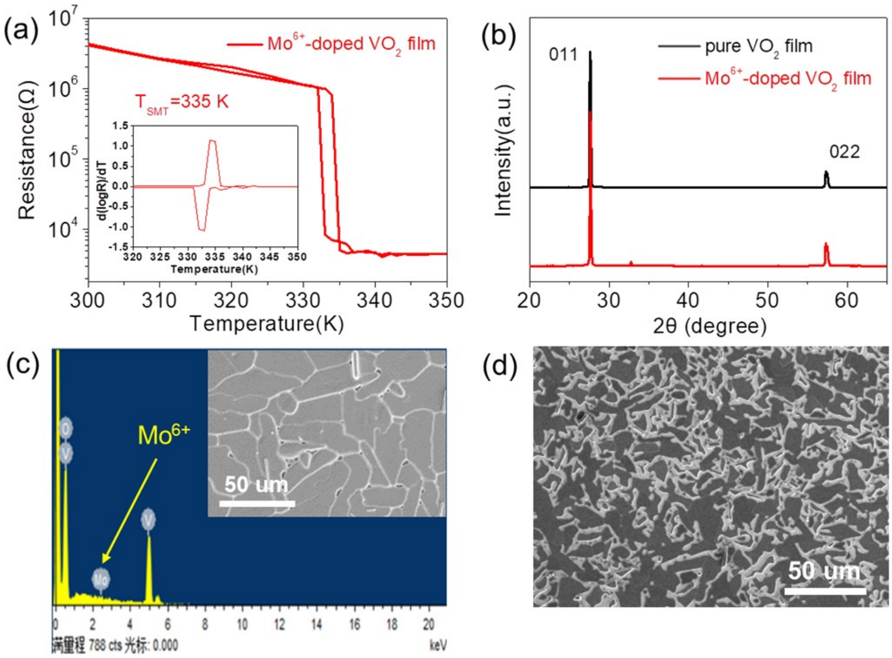

Figure S4. (a) Temperature-dependent resistance measurements of Mo^{6+}-doped VO_2 thin film, the inset is the first derivative of the temperature curves ($|d[\log(R)]/dT|$) for a clear view of the T_{SMT} of the doped film. (b) XRD pattern of pure and doped VO_2 thin films, no significant differences on crystal structures can be observed in the film after Mo atoms are introduced, which is in agreement with results reported for Mo-doped VO_2 films. (c) The EDS pattern of the doped VO_2 thin films. (d) SEM image of VO_2 thin films under 10 mg MoO_3 powder as doping agent.

5. IR response characteristics of VO_2 film device

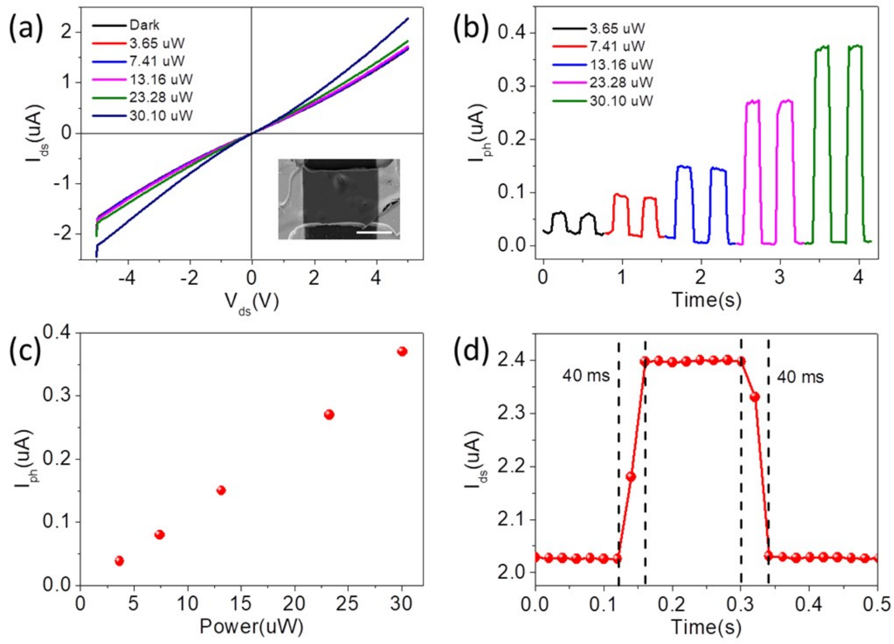

Figure S5. (a) I_{ds}-V_{ds} curves of the VO_2 film photodetector under dark and different IR radiation intensities, the inset is a typical SEM image of the device and scale bar is 20 μm. (b) Photo-switching characteristics of the photodetector under varying light power. (c) Photocurrent versus light power plot at bias of 5.0 V. (d) A single on/off cycle for estimating the rise and fall times.