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Oxygen Effect and Mechanism of Insulator-to-Metal Transition using Indirect Band in Vanadium Dioxide TETIANA SLUSAR, ETRI-Elec Telecomm Rsch Inst in Korea, JIN CHEOL CHO, Korea University of Science and Technology, AHRUM SOHN, Ewha Womans University in Korea, JEONGYONG CHOI, ETRI-Elec Telecomm Rsch Inst in Korea, DONG-WOOK KIM, Ewha Womans University in Korea, HYUN-TAK KIM, ETRI-Elec Telecomm Rsch Inst in Korea — The vanadium dioxide VO_2 is known as the Mott insulator and it undergoes the insulator-to-metal transition (IMT) near T_c =340 K. Under the external influence (doping, strain etc.) the T_c is reduced. To explain this behavior, we have used the Mott criterion proposing the critical carrier density n_c at MIT (metal to insulator). In this case, Mott derived n_c for the transition from metal to insulator. Therefore, n_c is regarded as the minimum carrier density in metal phase. However, in the reverse transition (insulator to metal), n_c cannot clarify the above behavior. Thus, a new model has been required. Here, we have grown VO_2 thin films under the different oxygen partial pressure conditions and studied the influence of oxygen deficiency on T_c of the IMT. For the analysis, we have measured the Hall voltage near T_c and a change of work function. Based on the experimental data we have proposed the model explaining T_c changes in VO_2. This model describes the excitation process of bounded charges in direct and indirect energy bands as a criterion of the IMT. Moreover, it is shown that it can serve as universal mechanism that describes the physics of the IMT in many MIT materials from the new point of view, different from that, suggested by Mott. It is the fundament for operation of new devices.

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