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Influence of oxygen molecular on electrical performance of multilayer WSe_2 TFT

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Recently, transition metal dichalcogenides (TMDs) have received considerable attention by their 2D layered structure and wide bandgap, which provides excellent property in electronic and optoeletronic applications. In order to be applied to CMOS circuits, carrier type control is essential and should be considered. In this study, in contrast to the ambipolar WSe_2 FETs, the unipolar p-type characteristics of the device can be realized by using RTA treatment in oxygen ambient and high-performance p-type multilayer WSe_2 FETs devices was demonstrated. The experimental results indicate that the field-effect mobility of hole will be enhanced 10^3 times larger than that of the device before annealing treatment. The on/off-current ratio will be improved as high as 10^7. The reason for such the enhancement is the rearrangement of charge carriers both on the top and at the bottom of the channel due to the adsorbed oxygen molecules, while the charge carriers of the intrinsic WSe_2 material would be uniformly distributed in the channel. The carrier concentration of the annealed device is higher than the pristine. Thus, the channel resistance would be lower and the mobility can be improved. In summary, our work provides a method to improve the device performance of WSe_2 FETs and can change the undesirable ambipolar transport to the unipolar, which is essential to the implementation of CMOS logic.

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