Controlled Charge Polarity in WSe_2 Field Effect Transistor Grown by Self-flux Method

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In two-dimensional (2D) materials, tungsten diselenied (WSe_2) has great potential for optical and electronic devices [1,2]. However, the quality of WSe_2 crystals, which is determined by the presence of defects and grain boundaries, currently restricts its performance in controlling charge carriers transport properties [3]. Consequently, the most significant issue is the achievement of superior growth of WSe_2 crystals and appropriate metal contacts. Here, we present a doping-free approach to manipulate the polarity of WSe_2 transistors by utilizing distinct metal contacts. We examined WSe_2 field-effect transistors (FETs) employing low and high work function metals. Our findings demonstrate a transition in polarity from n-type for In and Cr to p-type for Pd and Au, showcasing remarkably high on-off ratios (~10^7) and mobilities (~115 cm^2/V.s) at room temperature. In addition, we measured our WSe_2 FETs device across low and high work function metals to analyze the Schottky barrier diode behavior. The device exhibits an ideality factor of 1.4 and a rectification ratio of 10^2, suggesting that it has ideal diode properties attributed to a single WSe_2 channel grown by self-flux method. This straightforward polarity control technique can be further extended by utilizing contact architecture-based research in other 2D materials for future nano electrical and optoelectronic devices [4,5].

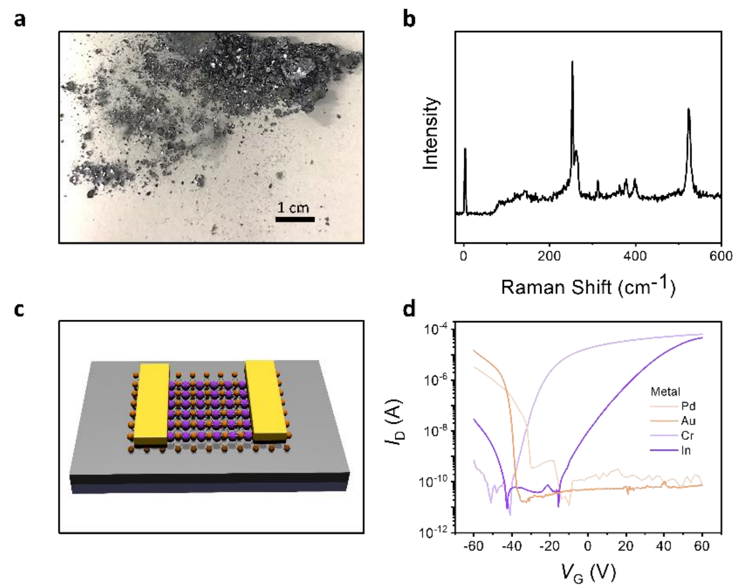

Fig. 1. Crystal grown by the flux method and device fabrication. a) WSe_2 crystal. b) Raman spectrum of WSe_2. c) Schematic diagram of WSe_2 field effect transistor. d) Transfer characteristics of WSe_2 contact with In, Cr, Pd and Au.

References

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