2D WSe_2 as an Intrinsic P-Type Channel Material for Field-Effect Transistor Applications

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Abstract

The demand for 2D material-based p-type transistors is increasing as the traditional silicon-based devices approach their high leakage current and short channel effects [1]. Among the 2D materials, WSe_2 has gained attention for thin-film transistors because of their p-type behaviour, low leakage current, and high on-off ratio, which has garnered considerable interest in their use in next-generation electronic devices [2, 3]. This study focused on the synthesis of a WSe_2 monolayer through a solid-state synthesis followed by a liquid-phase exfoliation technique. The structure of the monolayer WSe_2 was examined using X-ray diffraction (XRD) and Raman spectroscopy. The morphological studies were done by FESEM and TEM. The formation of the hexagonal WSe_2 is indicated by the presence of a prominent peak at the (002) plane of XRD spectra. The near overlap of E^1_{2g} and A_{1g} modes at 250 cm^{-1} in the Raman spectra reveals the formation of a WSe_2 monolayer [4]. The WSe_2-based thin-film transistor has been fabricated and demonstrates reliable switching behaviour (10^3–10^8 on-off ratio), reduced leakage current (10^{-9} A), enhanced noise immunity, and compatibility with CMOS technology. These findings confirm that 2D WSe_2 is a promising candidate for high-performance p-type transistors and emerging two-dimensional electronic devices.

References

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Figures

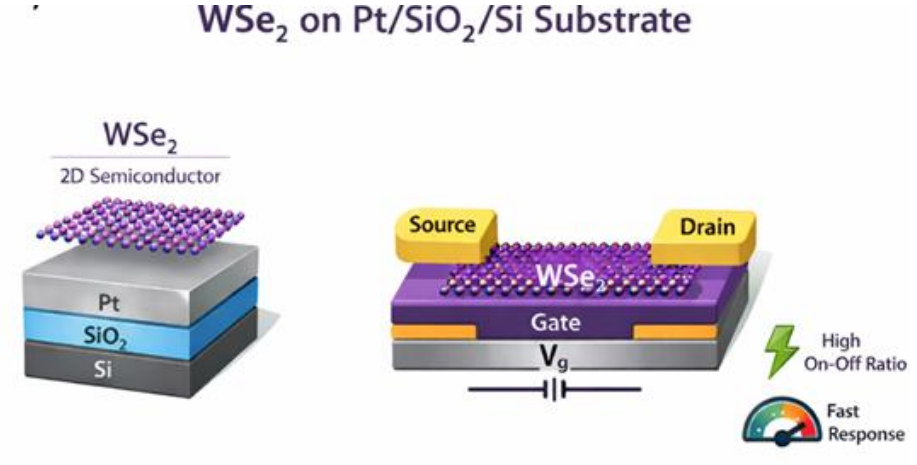

Figure Schematic of P-type transistor