2D materials based ISFETs for pH sensing applications

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During the past decade, triggered by theexciting properties of graphene, two-dimensional (2D) transition metaldichalcogenides (TMDCs) have emerged as potential candidate materials forfuture digital electronics and optoelectronics. TMDCs, such as molybdenumdisulfide (MoS_2), tungsten diselenide (WSe_2), and rhenium disulfide(ReS_2) are among themost intensively investigated (or being investigated) owing to their atomicthin layer thickness, sizable and tunable bandgap, high carrier mobilities,ease of miniaturization and flexibility to enable wearable electronics. Inparticular, their large surface-to-volume ratio makes 2D TMDCs very suitablefor sensor applications. In this talk, some recent work of 2D ReS_2FETs and their application for pH sensing will be presented. ReS_2FETs, fabricated on 20 nm thick HfO_2 on Si substrate, exhibit asmall threshold voltage of -0.5 V, a high on/off current ratio of up to $6+10^6$,and low SS of 116 mV/dec. pH sensing using ReS_2 FETs are thendemonstrated using HfO_2 sensing layer with a sensitivity of 54.8mV/dec. Low frequency noise characteristics of ReS_2 FETs aremeasured in both dry and pH sensing wet environment, and a detection limit of0.0132 pH is achieved. Our studies suggest the high potential of $ReS_2$for future low-power nanoelectronics and biosensor applications.