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Substrate Effect on Thin Layer $MoSe_2$ Field-Effect Transistors with Photo-Response MATTHEW Z. BELLUS, HUI-CHUN CHIEN, DAVID L. SICILIAN, BENJAMIN I. WEINTRUB, JATINDER KUMAR, A. DAVIS ST. AUBIN, University of Kansas, T.B. HOFFMAN, Y. ZHANG, J.H. EDGAR, Kansas State University, HSIN-YING CHIU, University of Kansas — The discovery of graphene has opened the gates for the study of layered semiconducting materials such as the transition metal dichalcogenides (TMDs), i.e. MoS_2, $MoSe_2$, WS_2, WSe_2. In addition, recent works have shown that hexagonal boron nitride (hBN) can act as an ideal substrate with electrical performance enhancement for graphene and possibly for other materials as well. In this study, we examine this substrate effect for $MoSe_2$ by comparing various material properties on both SiO_2 and hBN. Field-effect transistors (FETs) were fabricated on both substrates using mechanically exfoliated $MoSe_2$. Our FETs show n-type doping and strong gate modulation yielding I_{on}/I_{off} ratios larger than 10^6 for both substrates. Using a 4-probe measurement we found a relatively high mobility on SiO_2 that was larger than previous reports, with a slight variation between substrates. Under illumination, devices on both substrates showed "photo-doping" effects that in some cases were very large and persistent, thought to be the persistent photoconductivity (PPC) effect. These initial results have shown promising characteristics in $MoSe_2$ for applications in electronics and optoelectronics as well as shown the effects that a substrate can play in device performance and material properties.

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