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**2D Semiconductor Electronics: Advances, Challenges and Opportunities**

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Two-dimensional (2-D) semiconductors exhibit excellent device characteristics, as well as novel optical, electrical, and optoelectronic characteristics. In this talk, I will present our recent advancements in defect passivation, contact engineering, surface charge transfer doping, ultrashort transistors, and heterostructure devices of layered chalcogenides. We have developed a defect repair/passivation technique that allows for observation of near-unity quantum yield in monolayer $MoS_2$. The work presents the first demonstration of an optoelectronically perfect monolayer. Forming Ohmic contacts for both electrons and holes is necessary in order to exploit the performance limits of enabled devices while shedding light on the intrinsic properties of a material system. In this regard, we have developed different strategies, including the use of surface charge transfer doping at the contacts to thin down the Schottky barriers, thereby, enabling efficient injection of electrons or holes. We have been able to show high performance n- and p-FETs with various 2D materials, including the demonstration of a FET with 1nm physical gate length exhibiting near ideal switching characteristics. Additionally, I will discuss the use of layered chalcogenides for various heterostructure device applications, exploiting charge transfer at the van der Waals heterointerfaces. I will also present progress towards achieving tunnel transistors using layered semiconductors.