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Anisotropic Electron transport and device applications of atomically thin ReS_2 ERFU LIU, YAJUN FU, YAOJIA WANG, YANQING FENG, HUIMEI LIU, XIANGANG WAN, WEI ZHOU, BAIGENG WANG, JUNWEN ZENG, Nanjing University, CHING-HWA HO, YING-SHENG HUANG, National Taiwan University of Science and Technology, HONGTAO YUAN, HAROLD Y. HWANG, YI CUI, Stanford University, DINGYU XING, FENG MIAO, Nanjing University — Semiconducting two-dimensional transition metal dichalcogenides are emerging as top candidates for post-silicon electronics. While most of them exhibit isotropic behavior, lowering the lattice symmetry could induce anisotropic properties, which are both scientifically interesting and potentially useful. In this talk, we will present atomically thin rhenium disulfide (ReS_2) flakes with unique distorted 1T structure, which exhibit in-plane anisotropic properties. We first fabricated mono- and few-layer ReS_2 field effect transistors, which exhibit competitive performance with large current on/off ratios (~10^7) and low subthreshold swings (100 mV dec^{-1}). The observed anisotropic ratio along two principle axes reaches up to 3.1. Furthermore, we successfully demonstrated an integrated digital inverter with good performance by utilizing two ReS_2 anisotropic field effect transistors, suggesting the promising implementation of large-scale two-dimensional logic circuits. Recent results on ultra-high responsivity (as high as 88,600 A W^{-1}) phototransistors based on few-layer ReS_2 will also be discussed. Our results underscore the unique properties of two-dimensional semiconducting materials with low crystal symmetry for future electronic and optoelectronic applications.

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