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Nano-imaging of Electrical Properties of $MoSe_2/WSe_2$ Vertical Heterostructures. DI WU, Department of Physics, University of Texas at Austin, WEI LI, MARUTHI YOGEESH, AMRITESH RAI, SANJAY BANERJEE, DEJI AKINWANDE, Microelectronics Research Center, University of Texas at Austin, KEJI LAI, Department of Physics, University of Texas at Austin — Vertical van der Waals heterostructures of transition metal dichalcogenides (TMDs) with atomically sharp interfaces and well-controlled components exhibit exotic optical and electrical properties due to the strong interlayer coupling and lack of depletion area. It has been proposed that tunneling-assisted interlayer recombination of the majority carriers is responsible for the tunability of the electronic and optoelectronic processes. However, current researches are mostly based on macroscopic transport measurements, which provide little information on the nanoscale electronic properties of working devices. Here we demonstrate the electrical mapping of the local conductance in field-effect transistors (FETs) based on $MoSe_2/WSe_2$ vertical heterostructures by microwave impedance microscopy (MIM). The spatial evolution of the insulator-to-metal transition of both individual flakes and the heterostructure region is clearly resolved as a function of both back-gate voltage and tip bias. Moreover, the conductance mapping of heterostructure area clearly uncovers the screening effect during the charge accumulation, as well as the interaction between charge carriers during the transport process.

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