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Negative Differential Transconductance in a MoS2/WSe2 Heterojunction Field Effect Transistor AHMAD ZUBAIR, Massachussetts Institute of Technology, AMIRHASAN NOURBAKHSH, Massachussetts Institute of Technology, IMEC, MILDRED DRESSELHAUS, Massachussetts Institute of Technology, STEFAN DE GENDT, IMEC, TOMAS PALACIOS, Massachussetts Institute of Technology — In this work, we demonstrate the negative transconductance in heterojunction transistors made of two-dimensional materials for the first time. Negative transconductance plays a key role in multi-valued logic/memory and frequency multiplication circuits. The simpler fabrication method of stacked van der Waals heterostructures compared to the conventional bulk semiconductors and large area CVD growth of the layered 2D materials systems makes it a prime candidate for scalable novel applications of their heterostructures. Vertically stacked MoS_2/WSe_2 heterostructures are fabricated by mechanical exfoliation and an in-house dry transfer process. A two-step process of e-beam lithography and metal deposition (Au on MoS_2, and Pd on WSe_2) were performed to fabricate n-type MoS_2 and ambipolar WSe_2 FET. The transfer characteristics on the non-overlapping regions shows the expected characteristics of the n-type, MoS_2 FET and ambipolar WSe2 FET. At the same time, the transfer characteristics of the overlapping region between MoS_2 and WSe_2 show negative differential transconductance. With proper scaling and careful optimization this negative differential transconductance will lead to novel applications.

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