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Pronounced photovoltaic response from PN-junctions of multi-layered $MoSe_2$ on h-BN[1] SHAHRIAR MEMARAN*[2], NIHAR PRADHAN*, ZHENGGUANG LU, DANIEL RHODES, JONATHAN LUDWIG, QIONG ZHOU, NHMFL, Florida State Univ, PULICKEL AJAYAN, Rice Univ., DMITRY SMIRNOV, LUIS BALICAS, NHMFL, Florida State Univ — Transition metal dichalcogenides (TMDs) such as MoS_2, WSe_2, etc., are semiconducting van der Waals bonded solids which are exfoliable down to single atomic layers. Monolayers display unique optical as well as optoelectronic properties, while heterostructures incorporating graphene and multi-layered TMDs display pronounced photoconducting and photovoltaic responses. Here, we report the observation of rectification and enhanced photoconducting as well as photovoltaic, in lateral PN junctions based on multi-layered ambipolar $MoSe_2$ crystals stacked onto h-BN. Our PN junctions composed of $\sim$10 atomic layers are translucent enough to yield photoresponsitivities of 1 A/W, external quantum efficiencies exceeding 30 %, short circuit currents exceeding 10^3 A/cm^2, and photovoltaic efficiencies surpassing 5 % with fill factors of $\sim$70 %. These values compare favourably with those of transparent photovoltaic cells. Given that TMDs can be grown in large area, that their band gap(s) can be tuned by varying composition, and the available strategies for increasing their efficiency, our results suggest a remarkable potential for semi-transparent photovoltaic cells composed of just a few layers of TMDs.

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