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Electrical and optical properties of chemically doped p-type MoS_2
JOONKI SUH, University of California, Berkeley, TAE-EON PARK, Korea Institute of Science and Technology, DER-YUH LIN, National Changhua University of Education, SEFAATTIN TONGAY, Arizona State University, JUNQIAO WU, University of California, Berkeley — Molybdenum disulfide is a model example of two-dimensional semiconductors, holding promise for applications in optoelectronic devices and field-effect transistors. So far, however, its practical use has been exclusively restricted to native, n-type doping. Here we experimentally demonstrate stable p-type conduction in molybdenum disulfide substitutionally doped with niobium. This chemical doping leads to a degenerate hole density of $\sim 1.8 \times 10^{14}$ cm^{-2} and enables gate-tunable van der Waals p-n homo-junctions. Also, the p-type monolayer molybdenum disulfide exhibits a greatly enhanced and broadened photoluminescence compared to that acquired from undoped monolayers. Our study demonstrates the stable p-type doping in molybdenum disulfide, and also reveals an effective way to tailor optical and electrical properties of two-dimensional semiconductors with extrinsic dopants.

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