Few-layer MoSe$_2$ Ambipolar Field-Effect Transistors$^1$ BHIM CHAMLAGAIN, HSUN-JEN CHUANG, MEEGHAGE MADUSANKA PERERA, MING-WEI LIN, Wayne State University, JIAQIANG YAN, NIRMAL JEEVI GHIMIRE, DAVID MANDRUS, The University of Tennessee, ZHIXIAN ZHOU, Wayne State University — Field-effect transistors were fabricated from few-layer MoSe$_2$ quasi-two dimensional flakes produced by mechanically exfoliating high quality MoSe$_2$ crystals synthesized using a vapor transport method. Electrical transport measurement on back-gated MoSe$_2$ devices shows that they are n-type and their extrinsic mobility is in the range of 0.1 - 10 cm$^2$ V$^{-1}$ S$^{-1}$, similar to few-layer MoS$_2$ field-effect transistors. Ambipolar behavior is observed in ionic-liquid-gated MoSe$_2$ devices, with the On/Off current ratio exceeding $10^6$ for both electrons and holes. For the electron channel, the extrinsic mobility measured in the ionic-liquid-gate configuration increases by over an order of magnitude, which can be attributed to the reduction of Schottky barrier by the more efficient gating. In addition, the electron mobility increases with decreasing temperature above 250 K, suggesting that the phonon scattering is a significant contributor to the channel resistance. On the other hand, the hole mobility is substantially lower and does not show significant temperature dependence, which is likely due to the higher contact resistance for holes.

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Zhixian Zhou
Wayne State University

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