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Electrical Transport of High-Quality CVD-Grown $MoSe_2$ Nanoribbons

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Two-dimensional (2D) materials such as transition metal dichalcogenides are excellent candidates for creating novel nano-electronic and photonic devices. Previous research indicates that the edge states of MoS_2 could strongly influence its conductivity, and the 2D honeycomb structure enables different electronic performance along the zigzag and armchair edges. Understanding and controlling the conductivity is essential in devices like field effect transistors that use MoS_2 as the channel. To date, transport along edge states of $MoSe_2$ nanoribbons, which have substantially reduced dimensionality relative to 2D crystals, has not been explored. In this project, we used chemical vapor deposition (CVD) to synthesize $MoSe_2$ nanoribbons through directed growth on phosphine (PH_3)-treated Si substrates. This approach yields directed growth of monolayer $MoSe_2$ to form narrow (< 1μm) nanoribbons. Tip-enhanced photoluminescence (TEPL) maps reveal a significant difference between the emission intensity at the edges and center of the nanoribbon. To perform electronic transport measurements, we used e-beam lithography to pattern contacts on the nanoribbons in a Hall bar configuration with the side contacts at the edges and tips of the nanoribbons. The nanoribbon was encapsulated by hBN flakes, and select regions were etched to facilitate the fabrication of edge contacts to reduce contact resistance. The influence of edge states on the electrical performance of $MoSe_2$ nanoribbons was investigated by conductivity and Hall transport measurements. Current flow in the transverse and longitudinal directions of the nanoribbon was compared to analyze the importance of edge states on $MoSe_2$ nanoribbon conductivity.