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Fabrication of functional ultrathin single-crystal nanowires from quasi-one dimensional van der Waals crystals Ta_2(Pd or Pt)$_3Se_8$[1] XUE LIU, JINYU LIU, JIN HU, CHUNLEI YUE, ZHIQIANG MAO, JIANG WEI, Tulane University, YIBO ZHU, Columbia University, ANA SANCHEZ, University of Warwick, LIUBOV ANTIPINA, PAVEL SOROKIN, Technology Institute for Superhard and Novel Carbon Materials — Micromechanical exfoliation or wet exfoliation of two-dimensional van der Waals materials has triggered an explosive interest in 2D material research. In our work, we extend this idea to 1D van der Waals material. By using micromechanical exfoliation or wet exfoliation, 1D nanowire with size as small as six molecular ribbons can be readily achieved in the Ta_2(Pd or Pt)$_3Se_8$ system. The semiconducting properties of exfoliated $Ta_2Pd_3Se_8$ nanowires show n-type, whereas $Ta_2Pt_3Se_8$ nanowires are p-type. Our electronic band structure calculation for $Ta_2Pd_3Se_8$ nanowire reveals that from multi-ribbon to single-ribbon the band gap evolves from indirect 0.5eV in bulk to direct 1eV in single-ribbon. A functional "NOT" gate consisting of field-effect transistors based on these two types of complementary nanowires has also been successfully realized. Moreover, the photocurrent response of $Ta_2Pd_3Se_8$ nanowire transistors has been studied as well. Ta_2(Pd or Pt)$_3Se_8$ system, as an intrinsic quasi-1D material, provides a viable platform for the study of low dimensional condensed matter physics.

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