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Probing the Anisotropic Light-Matter Interaction in Ultrathin ReS_2 DANIEL CHENET[1], BURAK ASLAN[2], PINSHANE HUANG[3], CHRIS FAN, AREND VAN DER ZANDE[4], JAMES HONE, Columbia Univ, TONY HEINZ, Stanford Univ and SLAC — Rhenium disulfide (ReS_2) is a semiconducting layered group VII transition metal dichalcogenide that exhibits a stable distorted 1T phase. We demonstrate that the reduced crystal symmetry, as compared to the molybdenum and tungsten dichalcogenides, leads to anisotropic optical properties that persist from the bulk down to the monolayer limit. We find that the direct optical gap blueshifts from 1.47 eV in the bulk to 1.61 eV in the monolayer limit. In the ultrathin limit, we observe polarization-dependent absorption and polarized emission from the band-edge optical transitions. We thus establish ultrathin ReS_2 as a birefringent material with strongly polarized direct optical transitions that vary in energy and orientation with sample thickness. We also demonstrate the strong anisotropy in the Raman scattering response for linearly polarized excitation. Polarized Raman scattering is shown to permit a determination of the crystallographic orientation of ReS_2 through comparison with direct structural analysis by scanning transmission electron microscopy (STEM). Analysis of the frequency difference of appropriate Raman modes is also shown to provide a means of precisely determining layer thickness up to four layers.

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