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Coupling and Stacking Order of ReS_2 Atomic Layers Revealed by Ultralow Frequency Raman Spectroscopy CHUN HUNG LUI, Univ of California - Riverside, JIA-AN YAN, Towson University, ZONGYOU YIN, Massachusetts Institute of Technology, ZHIPENG YE, GAIHUA YE, JASON CHENG, University of Northern Iowa, JU LI, Massachusetts Institute of Technology, RUI HE, University of Northern Iowa — We investigate the ultralow-frequency Raman response of atomically thin ReS_2, a special type of two-dimensional (2D) semiconductors with unique distorted 1T structure. Bilayer and few-layer ReS_2 exhibit rich Raman spectra at frequencies below 50 cm^{-1}, where a panoply of interlayer shear and breathing modes are observed. The emergence of these interlayer phonon modes indicate that the ReS_2 layers are coupled and orderly stacked. Whereas the interlayer breathing modes behave similarly to those in other 2D layered crystals, the shear modes exhibit distinctive behavior due to the in-plane lattice distortion. In particular, the two shear modes in bilayer ReS_2 are nondegenerate and clearly resolved in the Raman spectrum, in contrast to the doubly degenerate shear modes in other 2D materials. By carrying out comprehensive first-principles calculations, we can account for the frequency and Raman intensity of the interlayer modes and determine the stacking order in bilayer ReS_2.

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