Interlayer breathing and shear modes in NbSe2 atomic layers

JEREMIAH VAN BAREN, UC Riverside, RUI HE, Univ of Northern Iowa, JIA-AN YAN, Towson Univ, XIAOXIANG XI, Penn State Univ, ZHIPENG YE, GAIHUA YE, Univ of Northern Iowa, I-HSI LU, S. M. LEONG, C. H. LUI, UC Riverside — Atomically thin NbSe2 is a metallic layered transition metal dichalcogenide (TMD) with novel charge-density-wave (CDW) and superconductive phases. Properties of NbSe2 atomic layers are sensitive to interlayer coupling. We investigate the interlayer phonons of few-layer NbSe2 by ultralow-frequency Raman spectroscopy. We observe both the interlayer breathing modes and shear modes at frequencies below 40 cm⁻¹ for samples of 2 to 15 layers. Their frequency, Raman activity, and environmental instability depend systematically on the layer number. In addition, the interlayer phonon modes evolve smoothly from T = 300 K to 8 K, with no observable response to the CDW formation in NbSe2. This finding indicates that the atomic registry between adjacent NbSe2 layers is well preserved in the CDW transition.

1Supported by NSF CAREER Grant No. DMR-1552482, RUI Grant No. DMR-1410496, and MRI Grant No. DMR-1337207.