Abstract

Understanding of electron–phonon coupling (EPC) in two-dimensional (2D) materials manifesting as phonon renormalization is essential to their possible applications in nanoelectronics. Here we report *in situ* Raman measurements of electrochemically top-gated 2, 3 and 7 layered 2H-$MoTe_2$ channel based field-effect transistors. While the E^1_{2g} and B_{2g} phonon modes exhibit frequency softening and linewidth broadening with hole doping concentration (p) up to ~$2.3 \times 10^{13}/cm^2$, A_{1g} shows relatively small frequency hardening and linewidth sharpening. The dependence of frequency renormalization of the E^1_{2g} mode on the number of layers in these 2D crystals confirms that hole doping occurs primarily in the top two layers, in agreement with recent predictions. We present first-principles density functional theory analysis of bilayer $MoTe_2$ that qualitatively captures our observations, and explain that a relatively stronger coupling of holes with E^1_{2g} or B_{2g} modes as compared with the A_{1g} mode originates from the in-plane orbital character and symmetry of the states at valence band maximum. The contrast between the manifestation of EPC in monolayer MoS_2 and those observed here in a few-layered $MoTe_2$ demonstrates the role of the symmetry of phonons and electronic states in determining the EPC in these isostructural systems.