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Observation of Interlayer Electron-Phonon Coupling in WSe2/hBN Heterostructures CHENHAO JIN, JONGHWAN KIM, JOONKI SUH, ZHIWEN SHI, UC Berkeley, BIN CHEN, XI FAN, Arizona State University, MATTHEW KAM, UC Berkeley, KENJI WATANABE, TAKASHI TANIGUCHI, National Institute for Materials Science, SEFAATTIN TONGAY, Arizona State University, ALEX ZETTL, JUNQIAO WU, FENG WANG, UC Berkeley — Van der Waals heterostructure of atomically thin two-dimensional (2D) crystals is an emerging class of material where the coupling between the adjacent layers can lead to new quantum phenomena that are completely different from the individual constituents. In condensed matter physics, the two most important many-body interactions are electron-electron coupling and electron-phonon coupling. Up until now, only electron-electron interactions between adjacent 2D layers have been extensively studied, and they have given rise to many fascinating physical behaviors. Here we report extraordinary interlayer electron-phonon interaction in WSe2/hBN heterostructure, where optically silent hBN phonons emerge in Raman spectra with surprisingly strong intensity through resonant coupling to WSe2 electronic transitions. Excitation spectroscopy reveals the double-resonance nature of such enhancement, and identifies the two resonant states to be the A-exciton transition of monolayer WSe2 and a new "hybrid" state present only in WSe2/hBN heterostructures. Our first observation of the interlayer electron-phonon interaction is important for fundamental understanding of van der Waals heterostructures, and can open up new ways to engineer electrons and phonons for novel device applications.

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