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Evolution of Direct and Indirect Band Gap by Inhomogeneous Strain in Monolayer MoS2-WSe2 and WSe2-MoSe2 Lateral Heterostructures WEI-TING HSU, LI-SYUAN LU, DEAN WANG, YI-CHIA CHOU, WEN-HAO CHANG, National Chiao Tung University, Taiwan, MING-YANG LI, JING-KAI HUANG, Academia Sinica, Taiwan, LAIN-JONG LI, King Abdullah University of Science and Technology, Kingdom of Saudi Arabia — Recently, heterostructures consisting of laterally connected transition metal dichalcogenides monolayers have attracted considerable interests and been demonstrated by chemical vapor deposition, paving the way for future planar device applications. In particular, the outer material usually exhibits pronounced strain inhomogeneity caused by lattice mismatch, as has been observed in MoS2-WSe2 heterostructures with strain variation up to ˜1.59%. In this work, the strain inhomogeneities in WSe2-MoS2 and MoSe2-WSe2 lateral heterostructures are investigated. Spatial-resolved photoluminescence (PL) shows a strong correlation between the PL intensity and energy caused by carrier occupation near the K valleys. This correlation can be modeled by considering the valley occupations according to the Boltzmann distribution, by which the energy difference and the ratio of deformation potential between K and vicinal valleys can be determined. Specifically, we found that the unstrained monolayer WSe2 is an indirect bandgap semiconductor, which can be tuned to direct bandgap under tensile strain. The local strain variation results in a spatial modulation of direct and indirect bandgap, with important implications for practical device applications.

Wei-Ting Hsu
National Chiao Tung University, Taiwan

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