



Extended Data Figure 4 | Optical properties of multi-junction MoSe₂-WSe₂ lateral heterostructure. **a**, Typical SEM image of a five-junction MoSe₂-WSe₂ monolayer lateral heterostructure corresponding to Fig. 1b. **b**, Optical microscope image of a large area of a five-junction MoSe₂-WSe₂ lateral heterostructure, corresponding to Fig. 1c showing the conformal growth of respective MoSe₂ or WSe₂ domains. **c**, **d**, Raman intensity map of five-junction MoSe₂-WSe₂ lateral heterostructure

corresponding to Fig. 1b, g, at frequencies 250 cm⁻¹ (**c**, WSe₂ domain) 240 cm⁻¹ (**d**, MoSe₂ domain). **e**, Composite Raman map image at 250 cm⁻¹ and 240 cm⁻¹. **f**, Optical image of a three-junction MoSe₂-WSe₂ monolayer lateral heterostructure corresponding to the inset of Fig. 1i. **g**, Raman peak position mapping between 236–255 cm⁻¹. **h**, Composite photoluminescence intensity mapping at 1.53 eV (MoSe₂ domain) and 1.6 eV (WSe₂ domain). Scale bars: **f–h**, 10 μm.