



Extended Data Figure 8 | Growth of three-junction $\text{MoS}_{0.64}\text{Se}_{1.36}$ – $\text{WSe}_{1.32}\text{S}_{0.68}$ lateral alloy heterostructure. **a**, Optical image of a three-junction $\text{MoS}_{2(1-x)}\text{Se}_{2x}$ – $\text{WS}_{2(1-y)}\text{Se}_{2y}$ monolayer lateral heterostructure. **b**, The corresponding low magnification optical image of the heterostructure shown in **a**. **c**, **d**, Raman (**c**) and photoluminescence (**d**) spectra corresponding to the optical image in **a** between points 1–4. **e**, Normalized photoluminescence contour

colour plot along the direction perpendicular to the interfaces, as shown in the optical image in the inset. **f**, **g**, Photoluminescence intensity maps at 1.61 eV (**f**, $\text{MoS}_{0.64}\text{Se}_{1.36}$ domain) and 1.71 eV (**g**, $\text{WSe}_{1.32}\text{S}_{0.68}$ domain) corresponding to the optical image in Fig. 3a. **h–k**, Raman intensity maps (Fig. 3a) at frequency 400.5 cm^{-1} ($A_{1g(\text{S-Mo})}$ modes, **h**); 264 cm^{-1} ($A_{1g(\text{Se-Mo})}$ modes, **i**); 404 cm^{-1} ($A_{1g(\text{S-W})}$ mode, **j**); and 256 cm^{-1} ($A_{1g(\text{Se-W})}$ mode, **k**). Scale bars: **f–k**, $10\text{ }\mu\text{m}$.