



Extended Data Figure 9 | Growth of three-junction $\text{MoSe}_{0.96}\text{S}_{1.04}$ - $\text{WSe}_{0.92}\text{S}_{1.08}$ lateral alloy heterostructure. **a, b,** Low-magnification optical images of three-junction $\text{MoS}_{2(1-x)}\text{S}_{2x}$ - $\text{WS}_{2(1-y)}\text{Se}_{2y}$ monolayer lateral heterostructure (corresponding to the optical image in Fig. 3b).

c, d, Typical large-area SEM image (**c**) and high magnification SEM image (**d**) of a single island showing the presence of different growth rates along the vertex and the axial directions. The $\text{MoS}_{2(1-x)}\text{S}_{2x}$ growth along the vertex direction is less than that of the axial direction.