**Electronic Supplementary Information**

# Interfacial bond engineering for direct integration of functional oxides with Si and Ge

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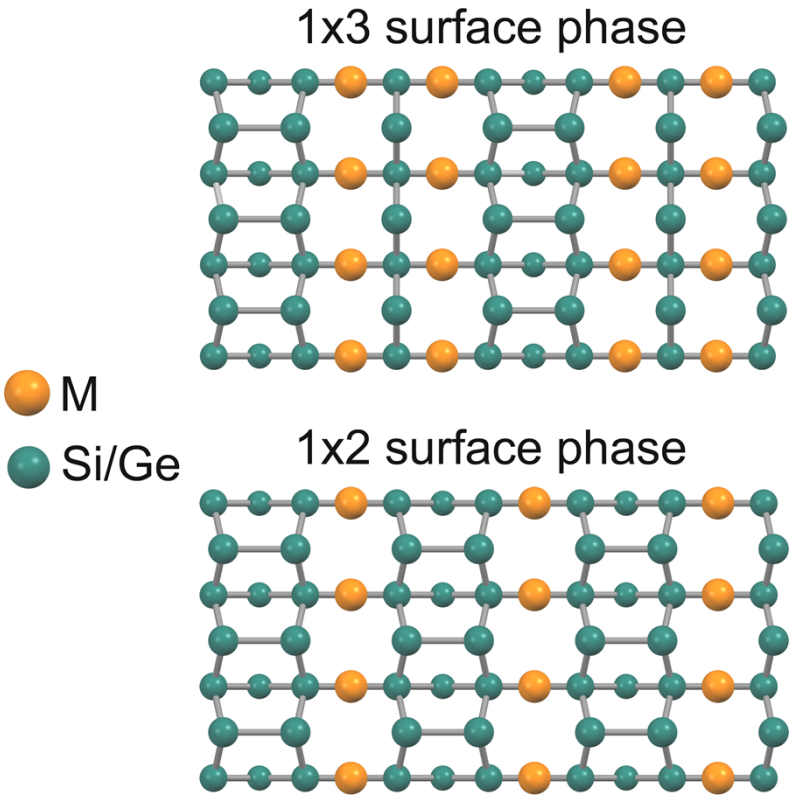


**Figure S1.** Ball-and-stick models of the 1×3 and 1×2 surface phases (top view). Green balls correspond to atoms of the substrate whereas orange balls correspond to metal atoms.

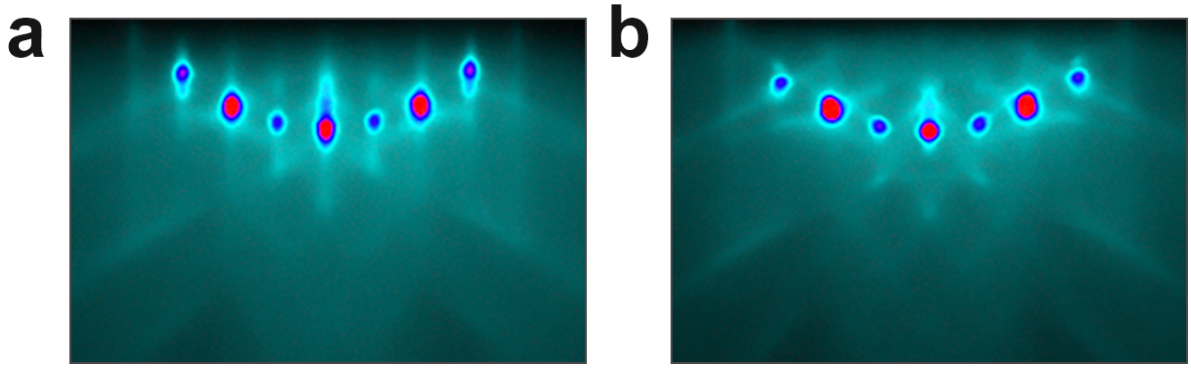


**Figure S2.** RHEED images along the [110] azimuth of clean (a) Ge(001) and (b) Si(001) with the 2×1 reconstruction of the surface corresponding to formation of Ge-Ge and Si-Si dimers.

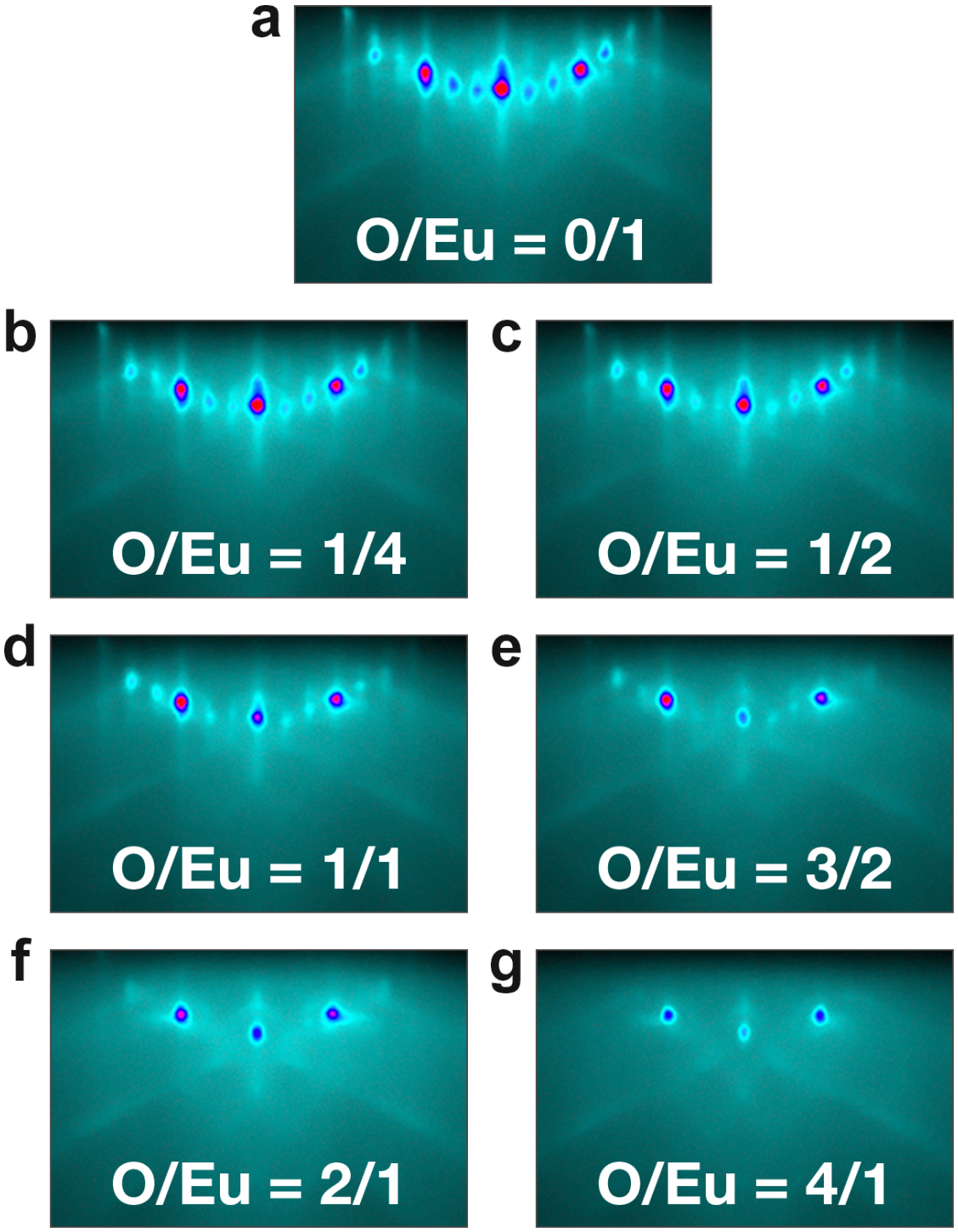


**Figure S3.** RHEED images along the Ge[110] azimuth: (a) the 1×3 surface phase of Eu on Ge(001); (b)-(g) 1×3 Eu/Ge(001) oxidized to (b) O/Eu = 1/4, (c) O/Eu = 1/2, (d) O/Eu = 1/1, (e) O/Eu = 3/2, (f) O/Eu = 2/1, (g) O/Eu = 4/1.

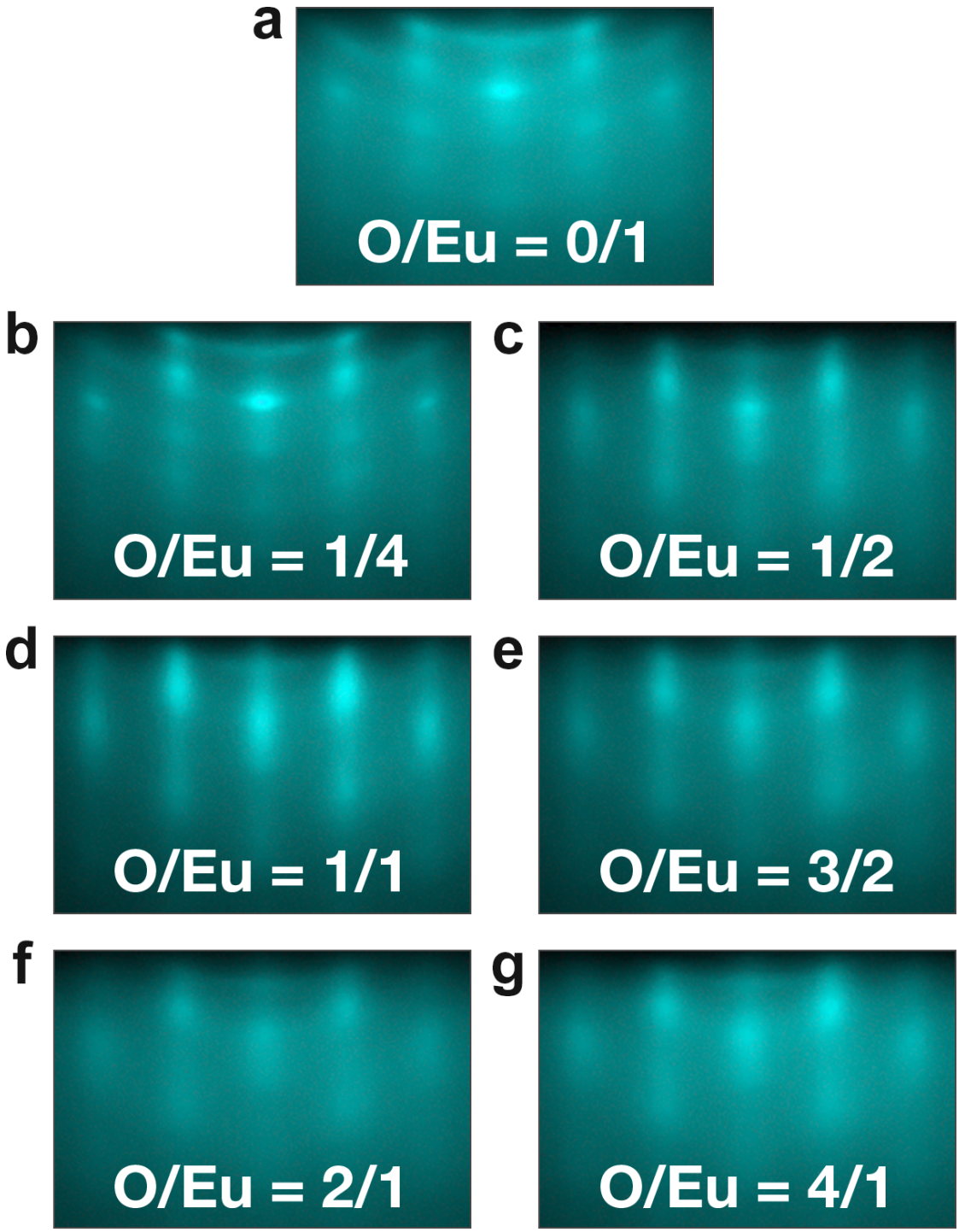


**Figure S4.** RHEED images along the Ge[110] azimuth of EuO films grown on (a) the 1×3 surface phase of Eu on Ge(001); (b)-(g) 1×3 Eu/Ge(001) oxidized to (b) O/Eu = 1/4, (c) O/Eu = 1/2, (d) O/Eu = 1/1, (e) O/Eu = 3/2, (f) O/Eu = 2/1, (g) O/Eu = 4/1.

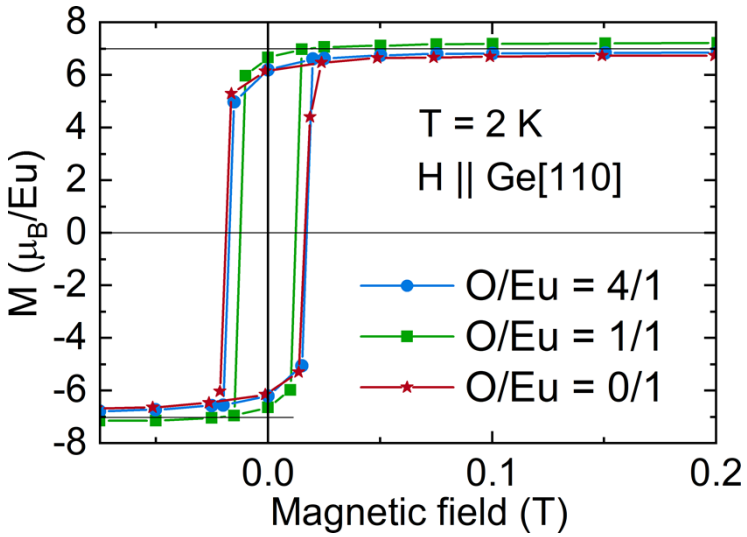


**Figure S5.** In-plane magnetic field dependences at 2 K of magnetic moment per Eu atom in EuO films on Ge(001) produced by synthesis on the 1×3 surface phase (red) and the same phase oxidized to O/Eu = 1/1 (green) and 4/1 (blue).

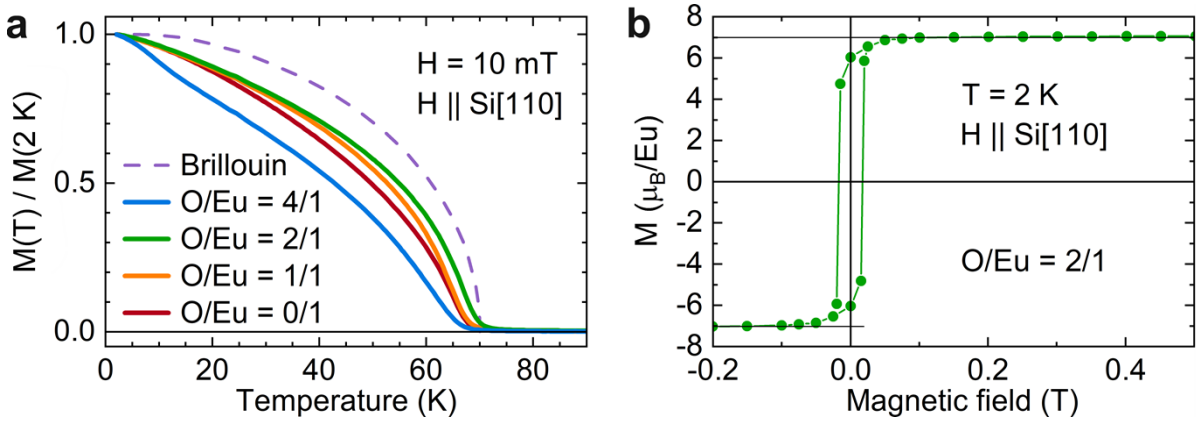


**Figure S6.** Magnetic properties of EuO films on Si(001). (a) Temperature dependences of normalized magnetic moment measured in a magnetic field of 10 mT along Si[110]. The films are produced by synthesis on the 1×3 surface phase (red) and the same phase oxidized to O/Eu = 1/1 (orange), 2/1 (green), and 4/1 (blue). For comparison, the $M(T)$ data are set against the corresponding Brillouin curve (dashed purple). (b) In-plane magnetic field dependence at 2 K of magnetic moment per Eu atom in EuO/Si(001) synthesized on the optimally oxidized 1×3 surface phase (O/Eu = 2/1).

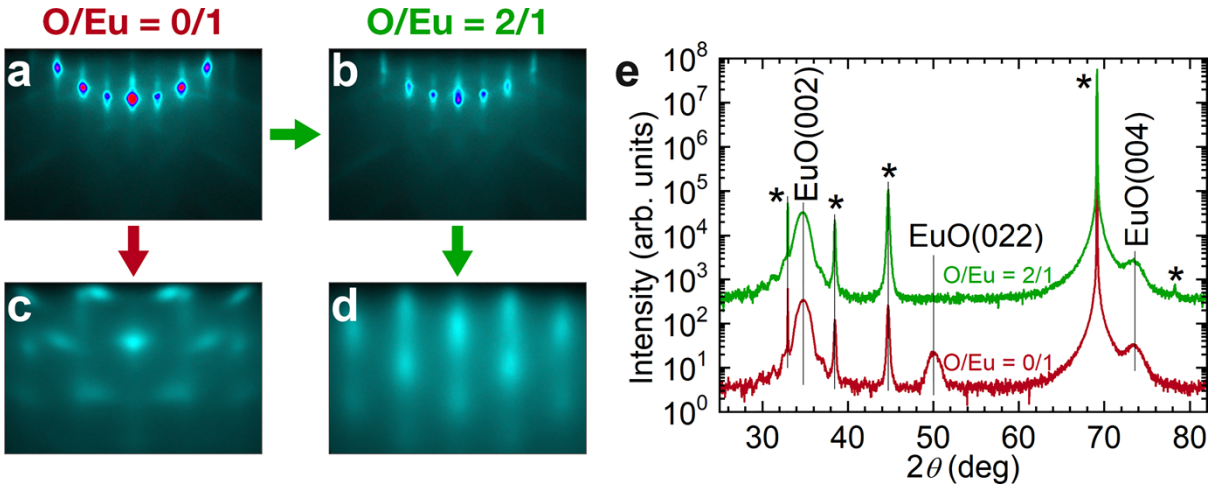


**Figure S7.** Comparison of two routes to EuO synthesis on Si(001). (a)-(d) RHEED images along the Si[110] azimuth: (a) the 1×2 surface phase of Eu on Si(001); (b) 1×2 Eu/Si(001) optimally oxidized to O/Eu = 2/1; (c) and (d) EuO films synthesized on the templates (a) and (b), respectively. (e) XRD θ-2θ scans for EuO grown on pristine (red) and optimally oxidized (green) templates of 1×2 Eu/Si(001). Asterisks mark peaks from the substrate and the capping layer.