Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting information for Simultaneous sulfidation of Mo and Co oxides supported on Au(111)

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S1. Moiré Structure of Co Oxide

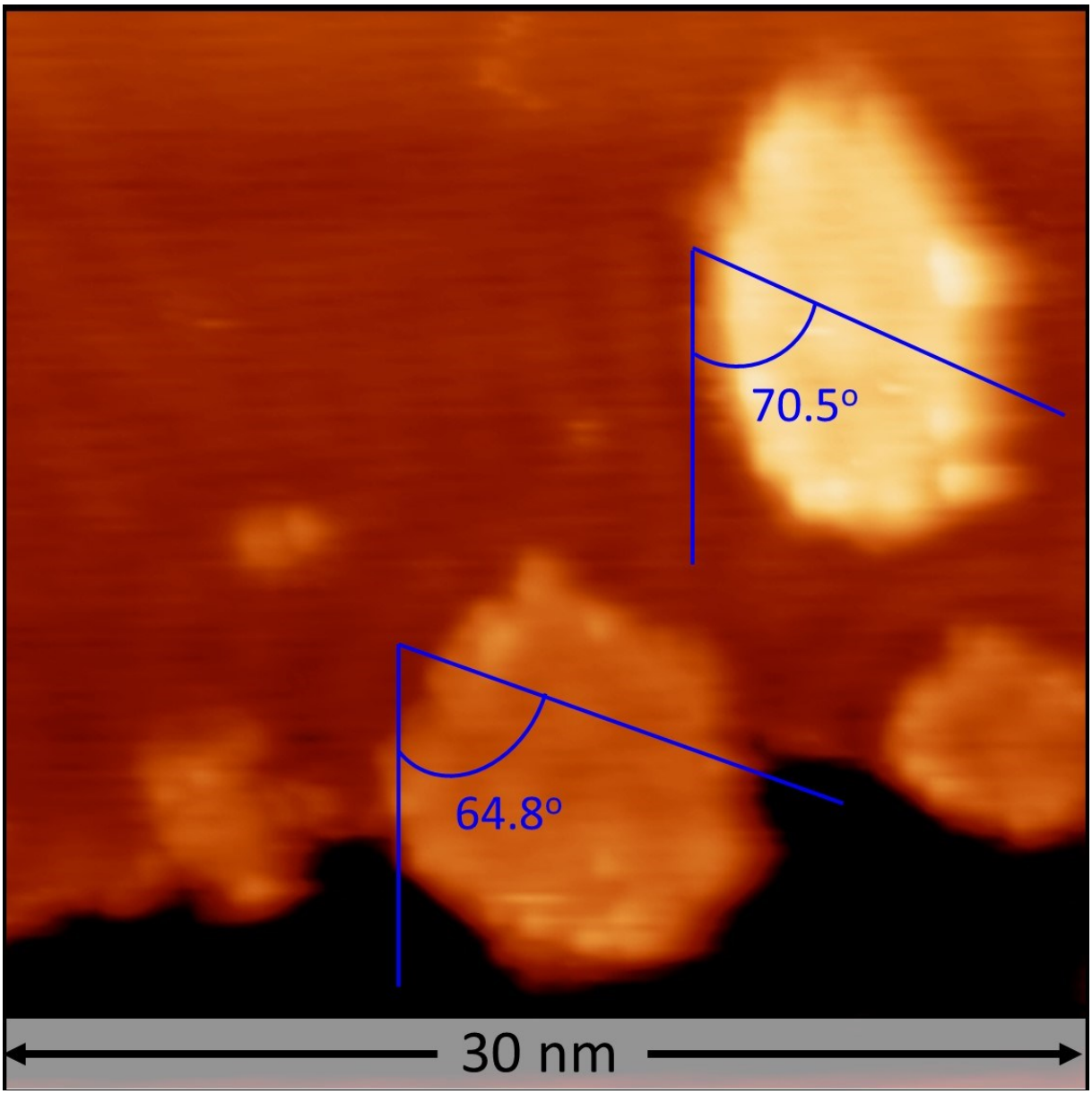

Fig. S1: Angle measurement of the hexagonal moiré pattern on single- and double-layer Co-O type slabs, tunneling current = 200 pA, sample voltage = -1.2 V. We measure a difference of ~6° in the direction of the moiré pattern of the higher slabs compared to the lower ones.

S2. Synthesis of Mo Oxide Nanoparticles on Au(111)

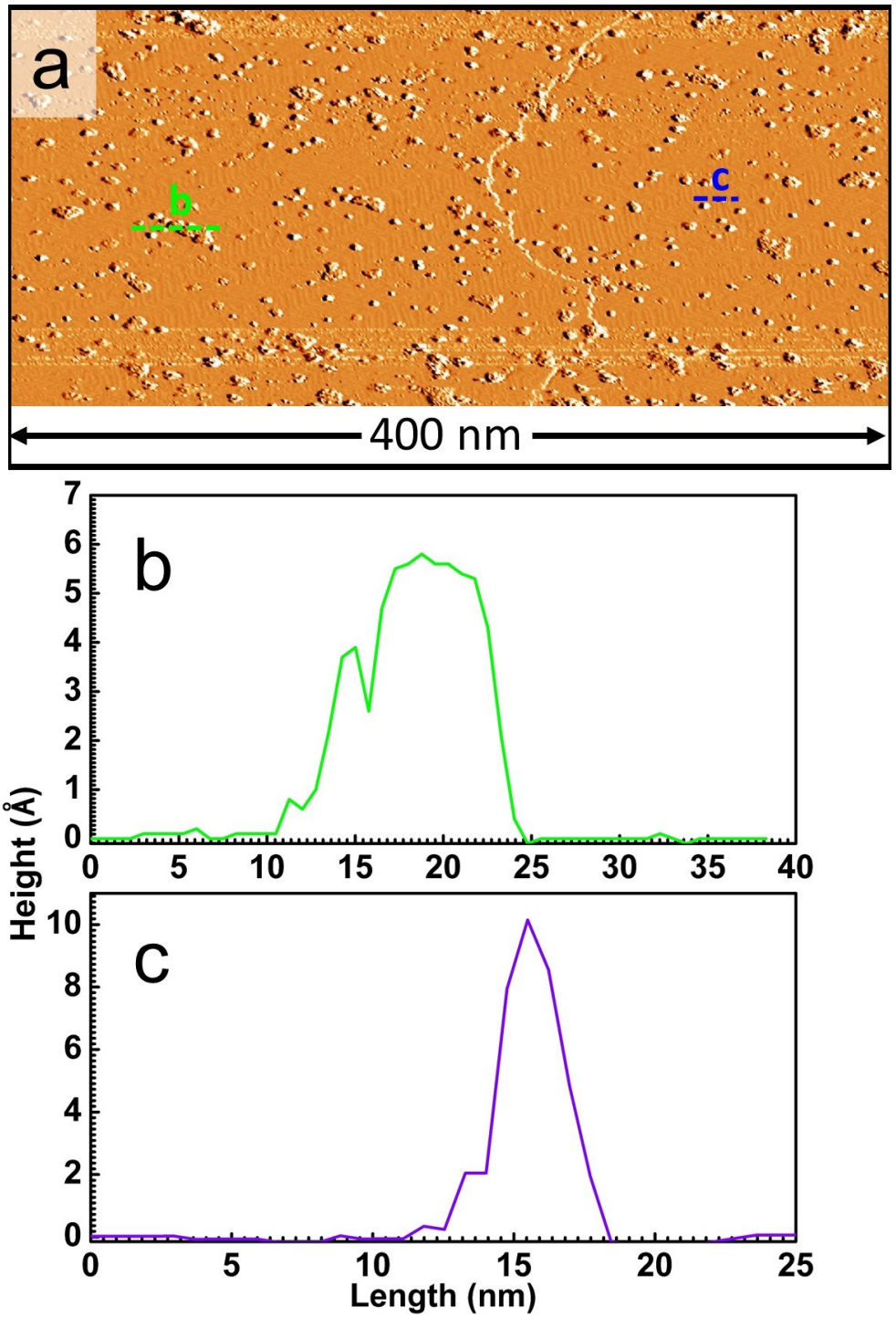

Fig. S2a): Large-scale STM image of Mo oxide nanoparticles on Au(111), sample voltage = -1.8 V, tunneling current = 200 pA. For clarity, the image is shown with a differential filter. The nanoparticles are grown by the method described in the experimental section; b) Measured height along the line marked b in Fig. S2a; c) The measured height along the line marked c in Fig. S2a.

S3. Measured STM Heights of Co and Mo Oxide Nanoparticles Supported on Au(111)

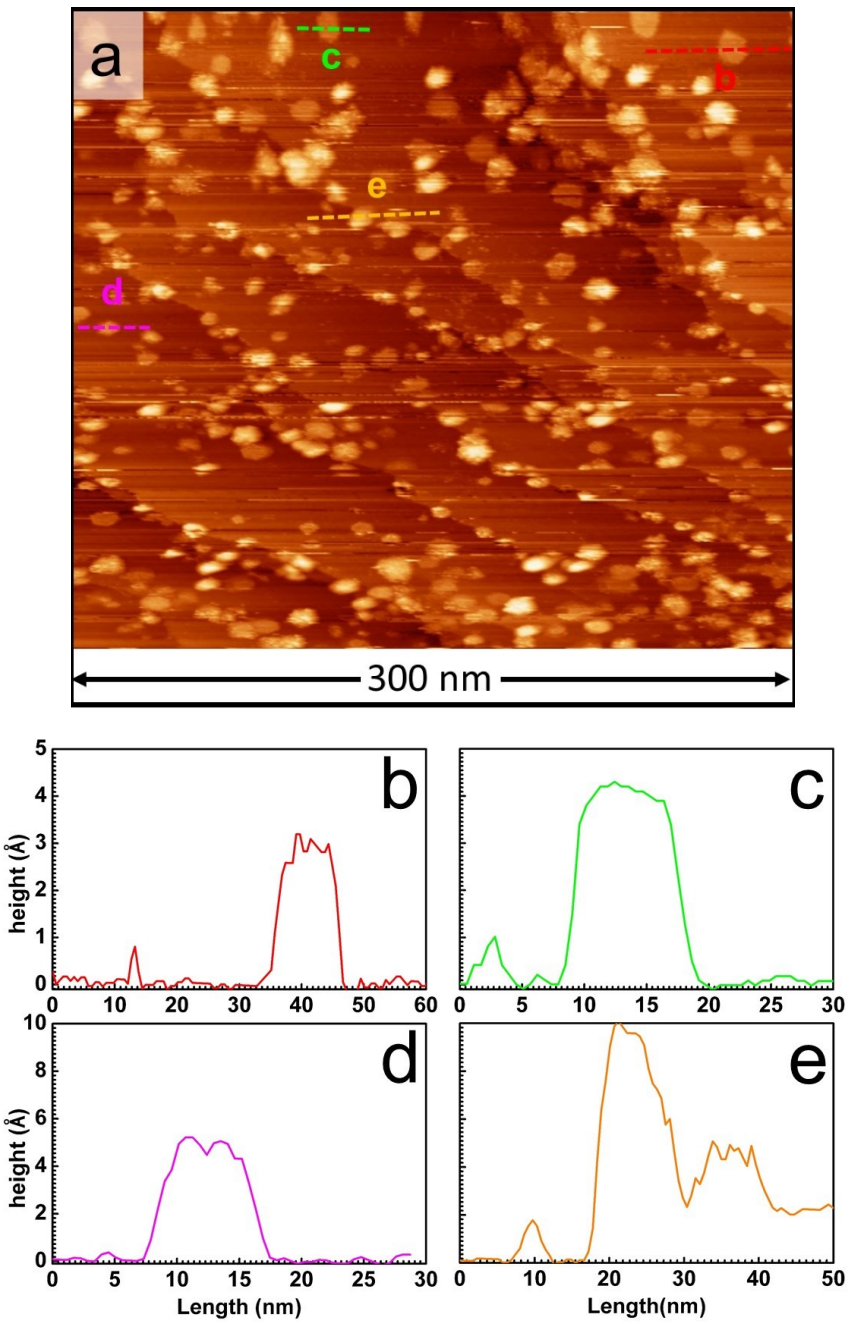

Fig. S3: Mo and Co oxide nanoparticles on Au(111), sample voltage = -1.7 V, tunneling current = 150 pA; a) Large-scale STM image obtained at 300 K in UHV; b-d) Measured heights of Co oxide slabs along the dashed lines in Fig. 1a with the respective colors, showing heights of 3 Å, 4 Å and 5 Å respectively; e) Measured height of an Mo oxide nanoparticle along the orange dashed line in Fig. 1a showing a height of 10 Å.

S4. STM Images of Co and Mo Oxides at Increased Sulfidation Times and Elevated Sulfidation Temperature

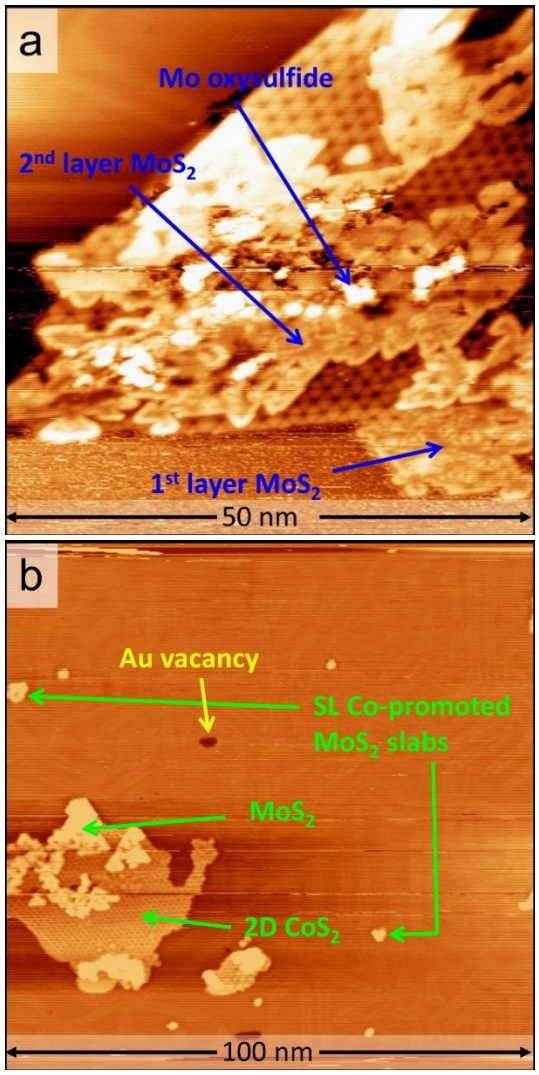

Fig. S4: STM images after sulfidation of a mixture of Mo and Co oxides on Au(111), sample voltage = -1 V, tunneling current = 100 pA; a) at 650 K for 90 minutes; b) at 730 K for 25 minutes.

S5. S 2p and O 1s XPS Spectra of Oxidic and Sulfided precursor

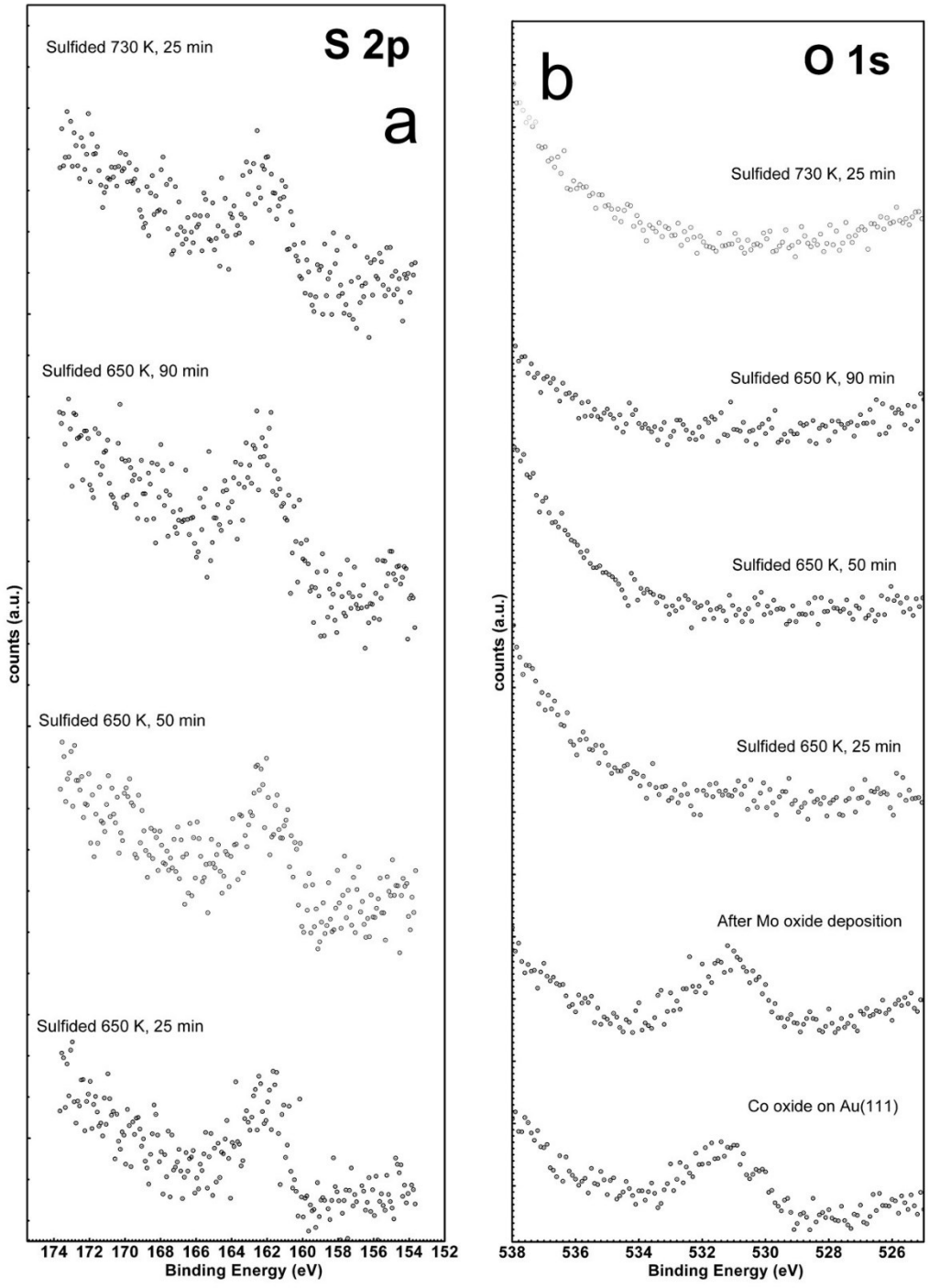

Fig. S5: a, b) XPS spectra of S 2p and O 1s regions respectively at various stages of oxide precursor synthesis and subsequent sulfidation.

S6. Atomic Model of the Co-Promoted MoS_2 Slab

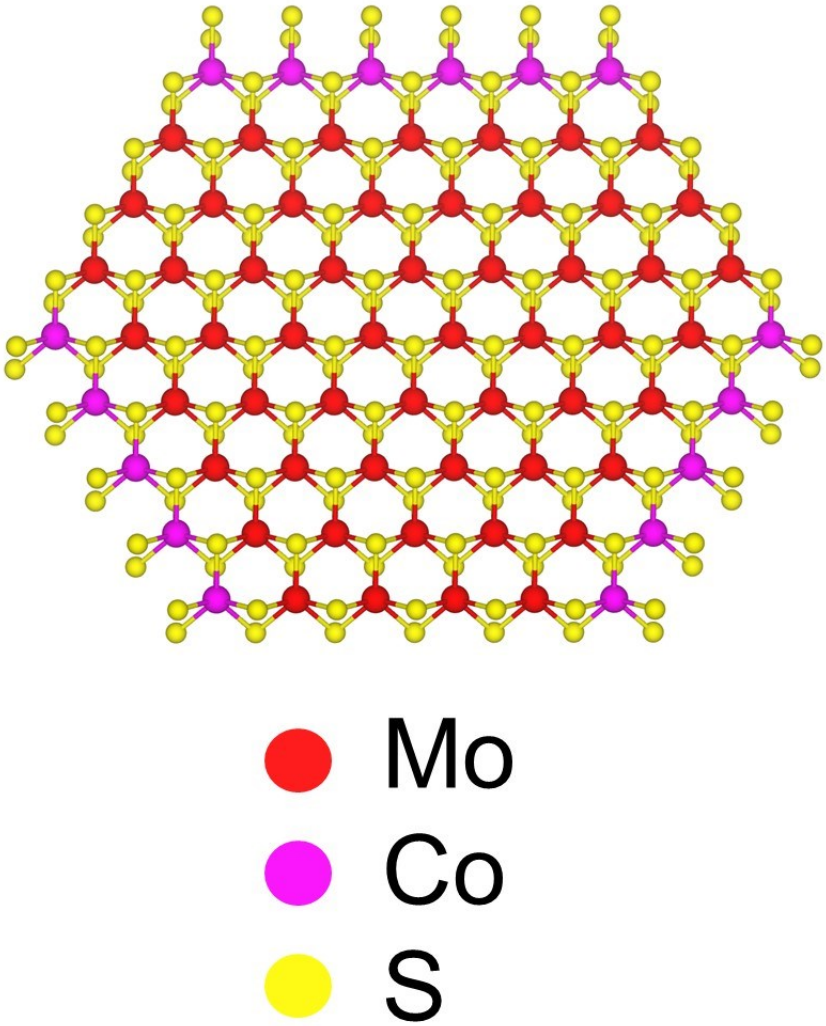

Fig. S6: Atomic model of a Co-promoted MoS_2 slab.

S7. Mixed Co and Mo Oxide Precursor Heated in the Absence of H_2S

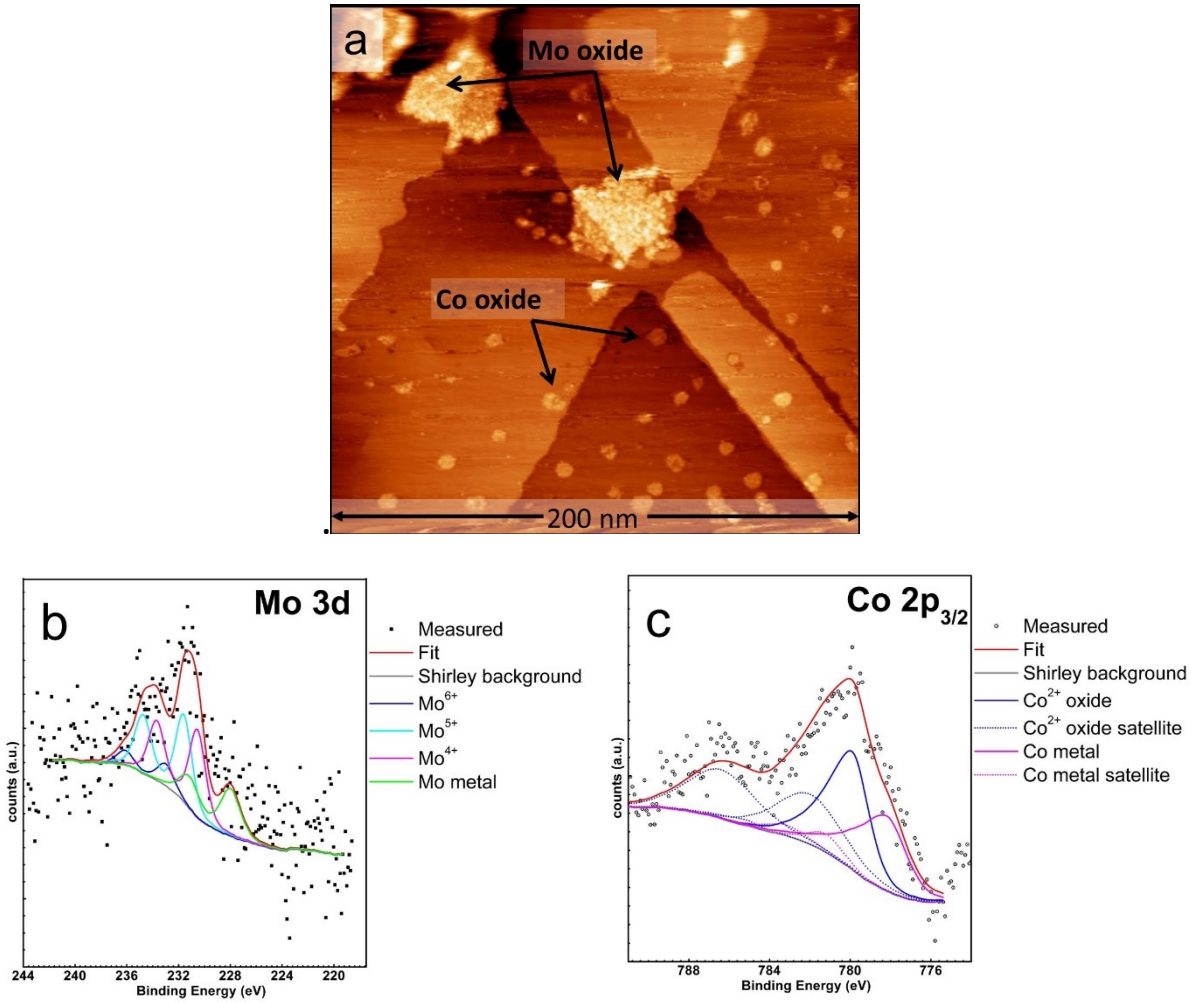

Fig. S7a) Large-scale STM image of a precursor containing Co oxide and Mo oxide slabs as in Fig. 2a, obtained after annealing to 650 K in a $5x10^{-7}$ mbar O_2 atmosphere, sample voltage = -1.5 V, tunneling current = 100 pA; b) Mo 3d XPS spectrum of the sample in Fig. S7a; c) Co $2p_{3/2}$ XPS spectrum of the sample in Fig. S7a.