

Imaging the confined surface oxidation of Ni₃Al(111) by in situ high temperature scanning tunneling microscopy

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List of supplementary information:

Movie relating to Fig. 1 - original STM data:

Growth of the moiré phase on Ni₃Al(111) upon oxygen dosing at 730 K. The displayed STM images are snapshots after dosing of 0.7 L, 29.1 L, 61.7 L and 111.7 L. The movie (see supplementary information) was taken at $U = 0.85$ V and $I = 0.4 \pm 0.1$ nA). Image size: $530 \text{ \AA} \times 530 \text{ \AA}$. The white circle at the lower terrace is a sputter defect of the Ni₃Al(111) crystal. Using this defect as reference point proves that the moiré phase grows towards the left side on the upper and towards the right side on the lower terrace at the same time.

Movies relating to Fig. 3 - original STM data and difference image data:

Moiré growth around a screw dislocation on the Ni₃Al(111) surface upon oxygen dosing at 725 K. Upper row: STM images acquired after O₂ dosing of a) 2.35 L and b) 37.11 L. c) Subtracting the subsequently recorded STM images from the first image of the dosing experiment leads to contrast in the resulting difference images that reflect the induced mass transport on the surface. Lower row: d) Measuring the areas where the moiré formation added material to the substrate (cov_add) and where it induced the removal of metal atoms from the terrace (cov_rem) allows to obtain quantitative results. e) The right panel evidences that cov_add and cov_rem are balanced (see text). The in-situ movie (see supplementary information) was acquired at $U = 0.85$ V, $I = 0.4 \pm 0.1$ nA, Image size: $530 \text{ \AA} \times 580 \text{ \AA}$.

Movies relating to Fig. 4 - STM movies relating to upper and lower row sequence:

Upper row: Snapshots of an in situ STM dosing experiment at 730 K (movie acquired at $U = 0.85$ V, $I = 0.5 \pm 0.1$ nA, see supplementary information). Lower row: O_2 dosing of 18 L in the LEED chamber at the 730 K followed by in situ O_2 dosing in the STM at the same temperature (movie acquired at $U = 0.85$ V, $I = 0.3 \pm 0.1$ nA, see supplementary information), Image sizes are: $700 \text{ \AA} \times 700 \text{ \AA}$.

Movie relating to Fig. 8 - original STM movie:

In situ oxygen dosing at 705 K (from left to right 14 L, 50 L and 66 L). The nucleation of the moiré surface oxide layer takes place at the step edge and within a larger terrace. During dosing a bilayer oxide island appears on the terrace (see arrow in the left panel) and nucleates the growth of a rotated moiré surface oxide layer around the seeding nucleus (movie in supplementary information). The rotational alignment of the two moiré phases ranges between 22° and 24° as determined by measuring the respective orientation of the straight oxide island edges (see white and black arrows). The image sequence was acquired at $U = 0.85$ V, $I = 0.4 \pm 0.1$ nA (movie in supplementary information), image size: $1000 \text{ \AA} \times 1000 \text{ \AA}$.

Movies relating to Fig. 10 - original STM data and difference image data:

Growth of the moiré surface oxide upon O_2 exposure at 735 K (left upper image: 0 L right upper image: 137 L). In the lower row the 0 L image is displayed indicating the areas of two subsequent terraces A and B, where the mass balance of the induced material transport was measured quantitatively. The mass transfer appears when subtracting the subsequently acquired STM images from the starting one at 0 L as shown in the right lower STM image: Here, removal of metal atoms is imaged dark and added metal appears bright. Visual inspection of the difference image and the extracted quantitative data of terrace A and B plotted in the right charts indicate that the material transport is balanced on each terrace, but not across steps. The data set was taken at $U = 0.85$ V, $I = 0.50 \pm 0.15$ nA (movie in supplementary information). Image size: $1500 \text{ \AA} \times 1500 \text{ \AA}$.