

# STM study of the Ga thin films grown on Si(111) surface

## Objective/ achievements

Study the structural grow of Ga thin films over silicon substrate, observe the different crystalline arrangement at different stages and temperatures of the synthesis of the film.

To demonstrate that there are delicate interactions between silicon and Ga, given that different phases were presented on the first two layers in contrasting with further Ga layers synthesized.

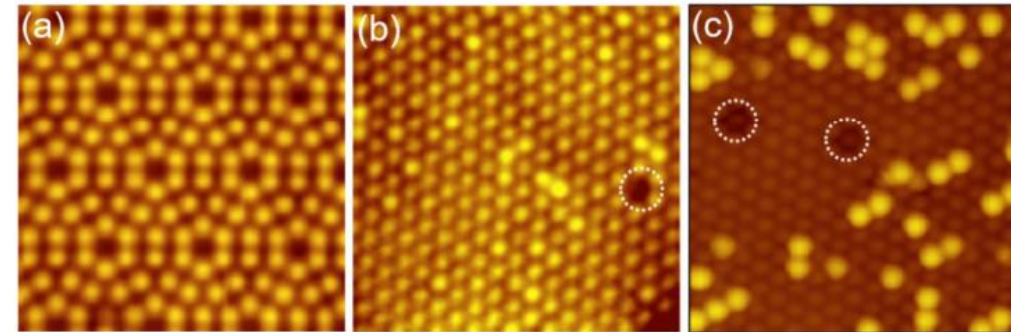
## Sample preparation

Ga atoms were thermally evaporated onto the cleaned Si substrate from a quartz crucible, which controlled the current, temperature was simultaneously measured by an infrared thermometer.

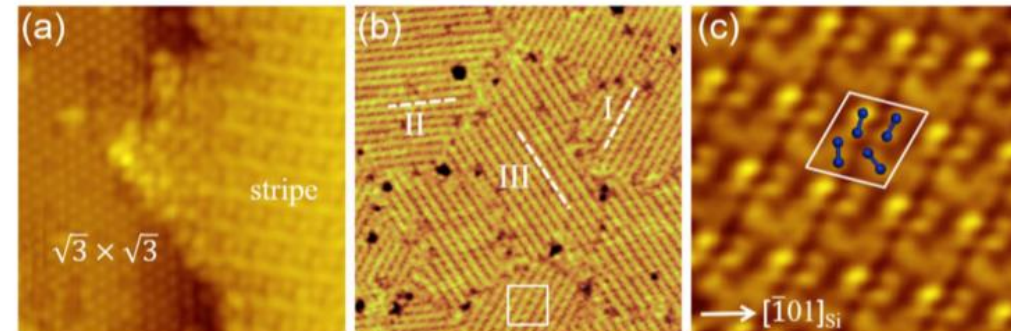
## Data acquisition conditions

"The experiments were performed in a Unisoku ultra-high vacuum LT-STM system with the base pressure maintained at  $1.2 \times 10^{-10}$  mbar. Electrochemically etched tungsten tips, subsequently heated by electron beam, were used for STM imaging. STM images were obtained at liquid nitrogen temperature (78 K) under constant-current mode."

## Representative figure /results



**Fig. 1.** (a) STM image of the Si(111)- $7 \times 7$  surface ( $10 \times 10 \text{ nm}^2$ , 1.6 V). (b) STM image of the Si(111)- $\sqrt{3} \times \sqrt{3}$ -Ga obtained by depositing  $-1/3$  ML Ga with subsequent annealing to  $550^\circ \text{C}$  ( $10 \times 10 \text{ nm}^2$ , 2.5 V). (c) Excess Ga atoms (bright protrusions) on the Si(111)- $\sqrt{3} \times \sqrt{3}$ -Ga surface ( $10 \times 10 \text{ nm}^2$ , -1.8 V). The white circles in (b) and (c) indicate the vacancies of Ga atoms.



**Fig. 2.** (a) The STM image of Ga submonolayer,  $15 \times 15 \text{ nm}^2$ , 2.2 V. (b) Three types of striped domains of the first Ga layer aligned at the principal axes of the Si(111) ( $50 \times 50 \text{ nm}^2$ , 2.0 V). (c) High-resolution STM image of the first Ga layer corresponding to the white box in Domain-I of (a) ( $6 \times 6 \text{ nm}^2$ , -1.2 V). A unit cell consisting of four Ga dimers is marked.

## Reference

M.-L. Tao, Y.-B. Tu, K. Sun, J. Ye, S.-J. Hao, H.-F. Xiao, Y.-L. Wang, Z.-B. Xie, and J.-Z. Wang, "STM study of the Ga thin films grown on Si(111) surface", Surface Science, vol. 663, pp. 31 - 34, 2017, issn: 0039-6028. doi: <https://doi.org/10.1016/j.susc.2017.04.006>. [Online]. Available: <http://www.sciencedirect.com/science/article/pii/S0039602817301334>.

## Surface Science

