Tlenek galu otrzymywany metodą osadzania warstw atomowych (ALD) z wody i ozonu

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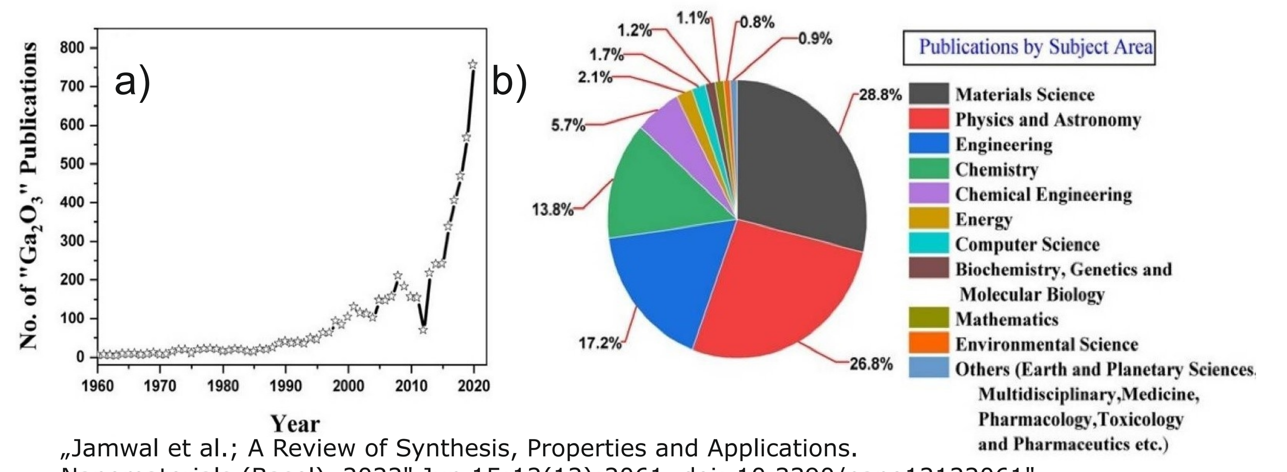
Introduction

Gallium was discovered in the 19th century. However, it was in the 1960s when researchers started researching the various structures of gallium oxide. Gallium oxide (Ga_2O_3) is a wide-band gap material. The optical band gap of single-crystal Ga_2O_3 has been measured to be ~4.9 eV. The conductivity of single-crystal Ga_2O_3 can vary from insulator to conductor. Due to its varied optical and electronic properties, Ga_2O_3 has been used for a wide variety of applications such as optical window, high temperature chemical gas sensor, magnetic memory, and dielectric layer. Recently, Ga_2O_3 thin films has attracted interest for many applications especially for optoelectronics.
The right graph: (a) the number of publications of gallium oxide over the years from 1960 to 2020, (b) the number of publications based on subject area.



„Jamwal et al.; A Review of Synthesis, Properties and Applications. Nanomaterials (Basel). 2022" Jun 15;12(12):2061. doi: 10.3390/nano12122061"

Growth method - Atomic Layer Deposition

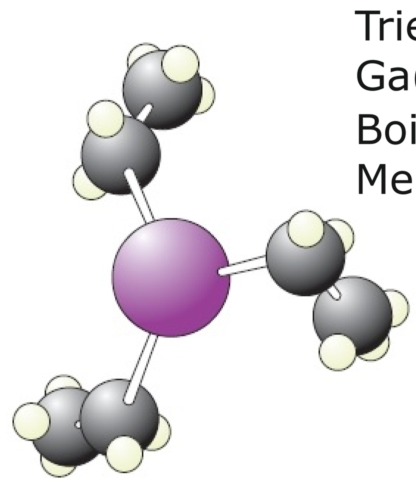
ALTERNATE SUPPLY OF COMPONENTS
- ⋆ No reaction in gas phase
- ⋆ Possibility of use of aggressive precursors
- ⋆ Low growth temperature is possible!

HIGH UNIFORMITY
- ⋆ Covering a very complicated structures

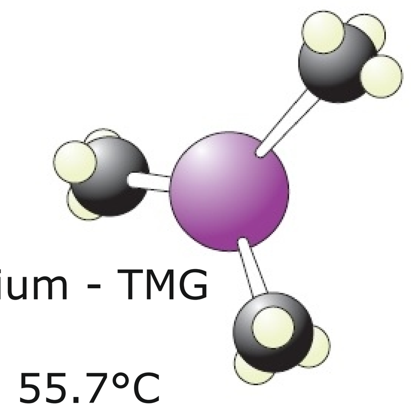
SELF-LIMMITING PROCES
- ⋆ Growth rate is NOT dependent on flux homogeneity
- ⋆ Maximal growth rate 1ML per cycle

Savannah-100 reactor from Ultratech/CNT (Veeco, San Jose, CA, USA)

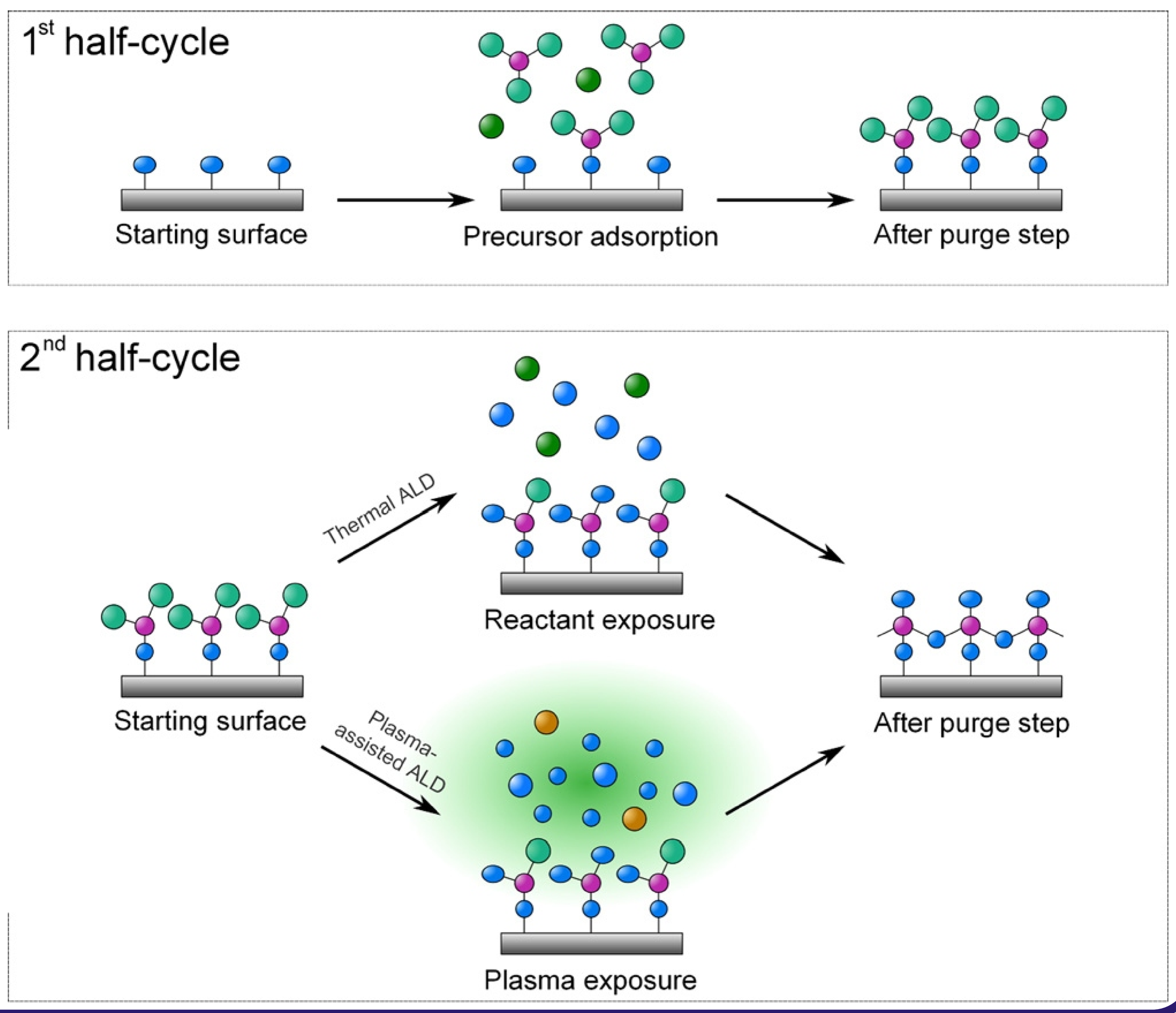
Growth temperature: 280 - 300°C



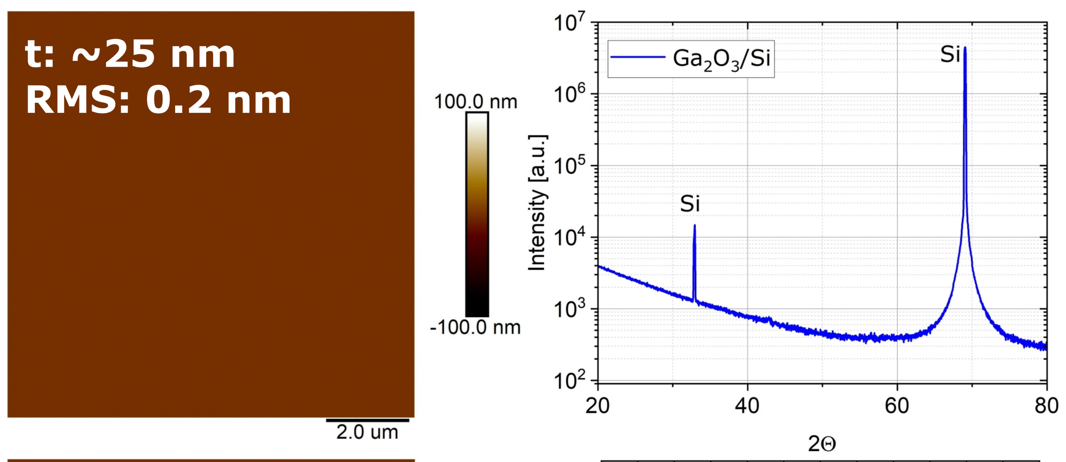
Triethylgallium - TEG
$Ga(C_2H_5)_3$
Boiling Point: 143°C
Melting Point: -82.3°C

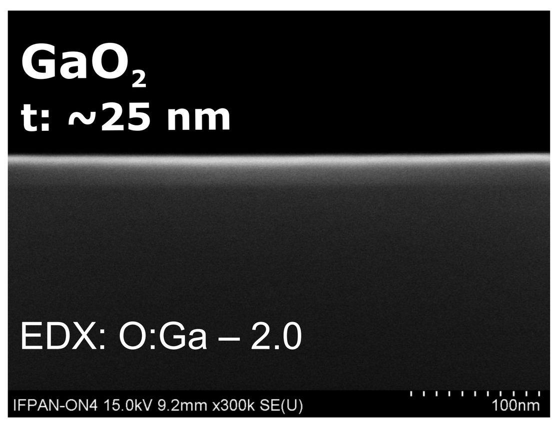


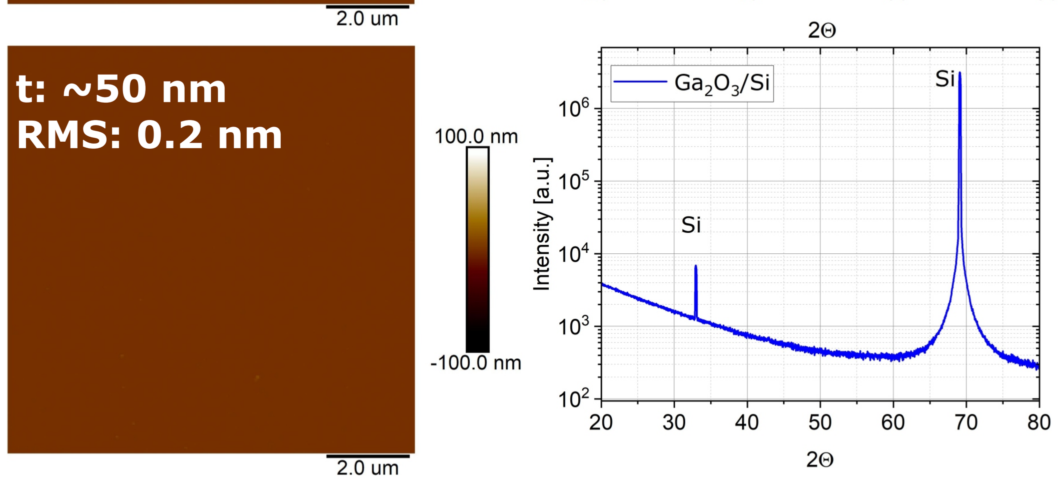
Trimethylgallium - TMG
$Ga(CH_3)_3$
Boiling Point: 55.7°C
Melting Point: -15.8°C



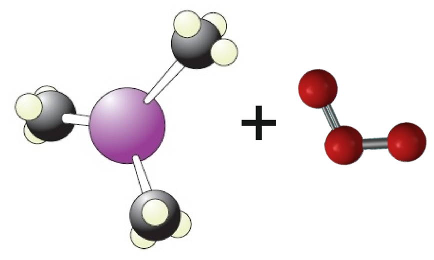
Morfology & structural measurements - TMG



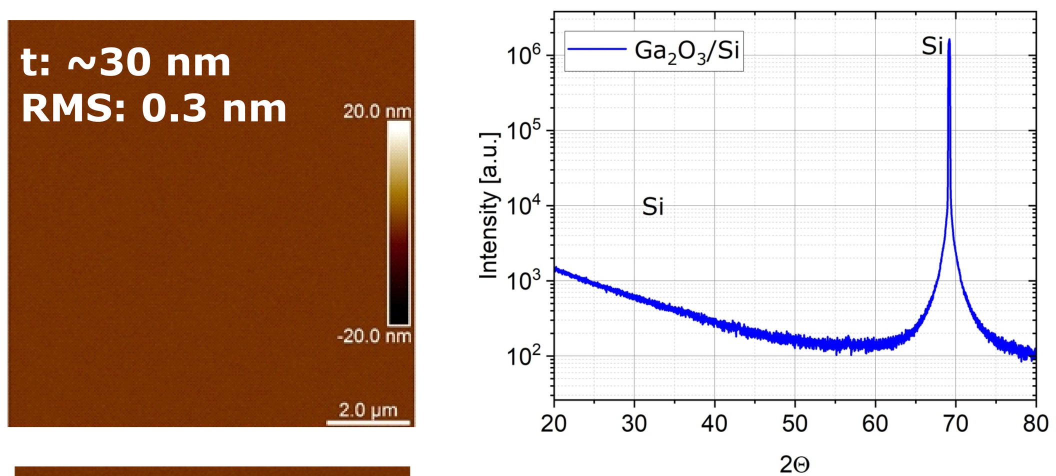


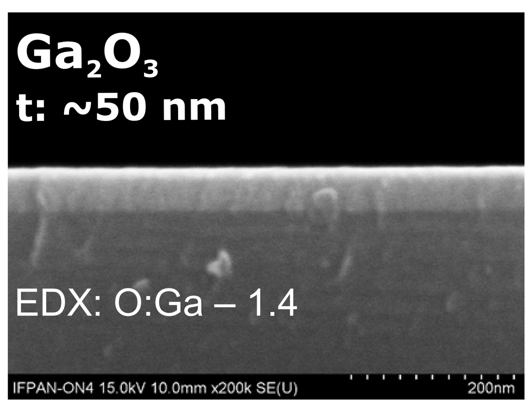


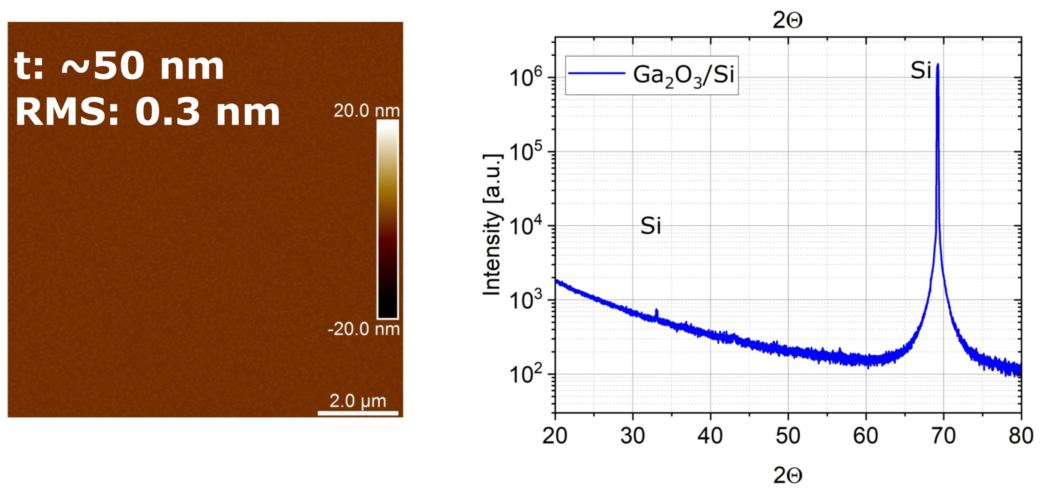
Growth per cycle ~0.5 A/cycle



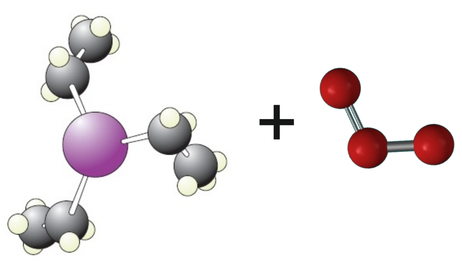
Morfology & structural measurements - TEG



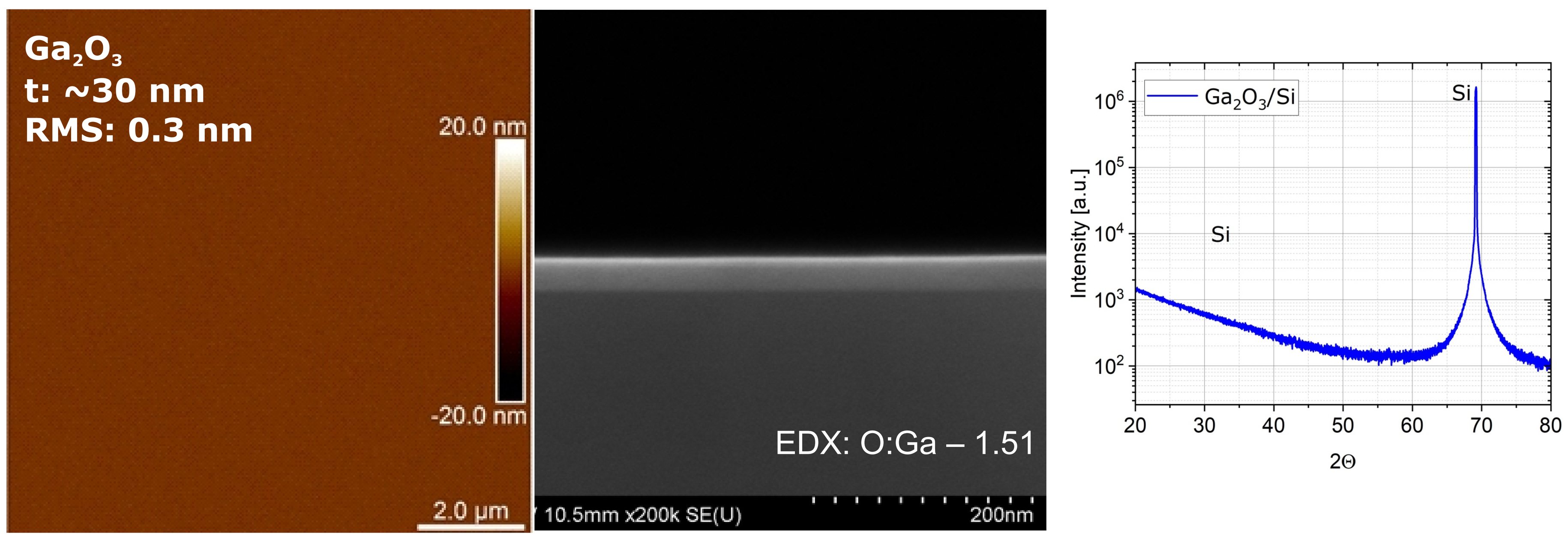


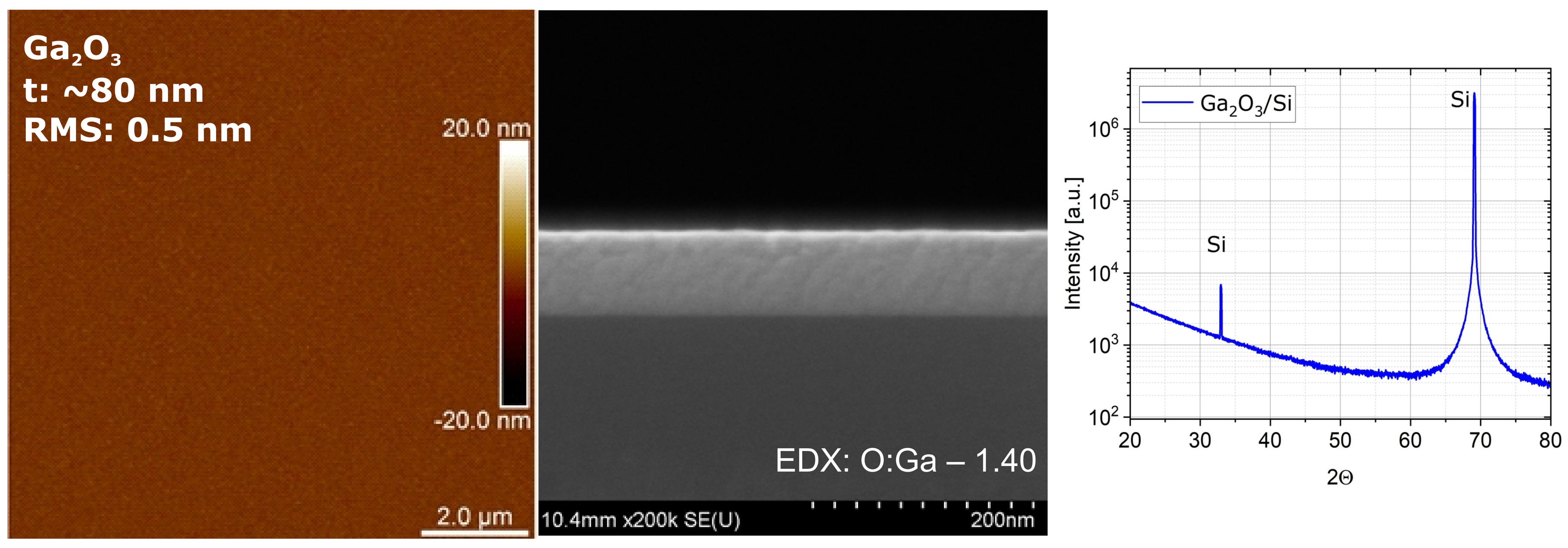


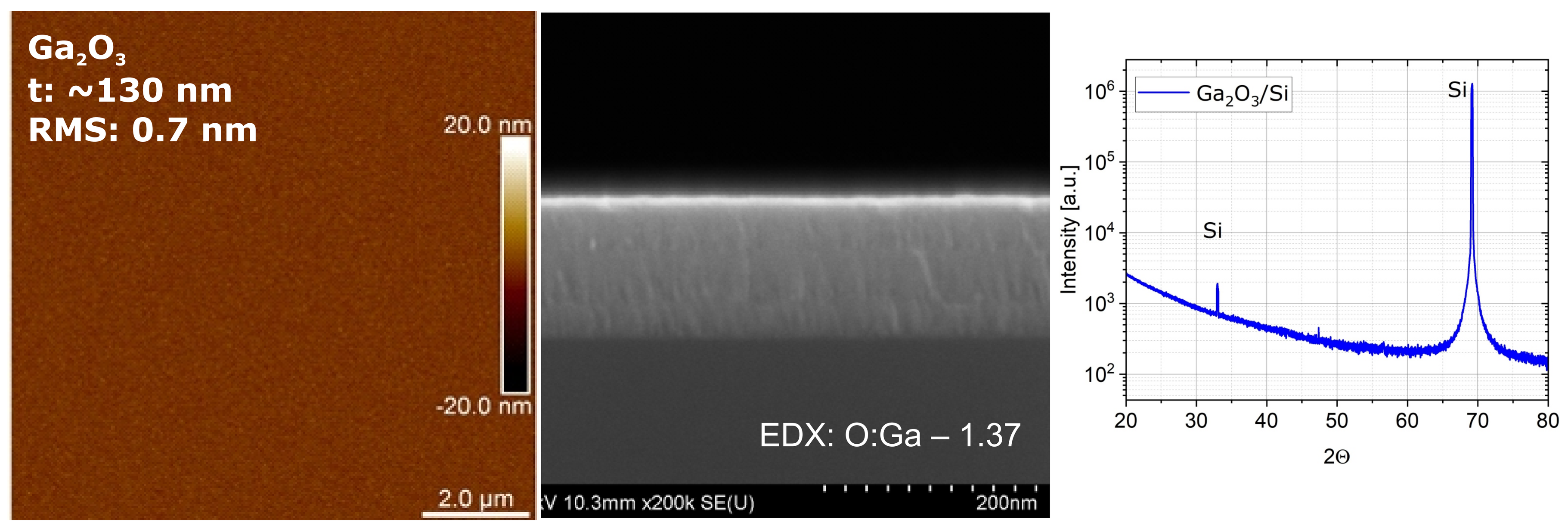
Growth per cycle ~0.3 A/cycle



Morfology & structural measurements - TEG







Resistivity: >100 MOhm

Conclusions

In the present work, Ga_2O_3 thin films were obtained by the atomic layer deposition (ALD) method. These layers were deposited using two of listed precursors: H_2O, O_3, C_3H_9Ga (TMG), $C_6H_{15}Ga$ (TEG). The optimization of ALD growth conditions for Ga_2O_3 was reported. This step enabled us deposition of uniform and conformal Ga_2O_3 films with a very flat surface (RMS < 0.5 nm) suitable for the above-mentioned applications. Oxygen and gallium precursors did not react at low temperatures (<280C). In the next step, Ga_2O_3 layers will be deposited with Sn and at higher temperatures. Properties of the obtained layers were determined from the results of X-ray diffraction (XRD), scanning electron microscope (SEM) with energy-dispersive X-ray spectrometer (EDX) and atomic force microscope (AFM) investigations.

Acknowledgement

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