

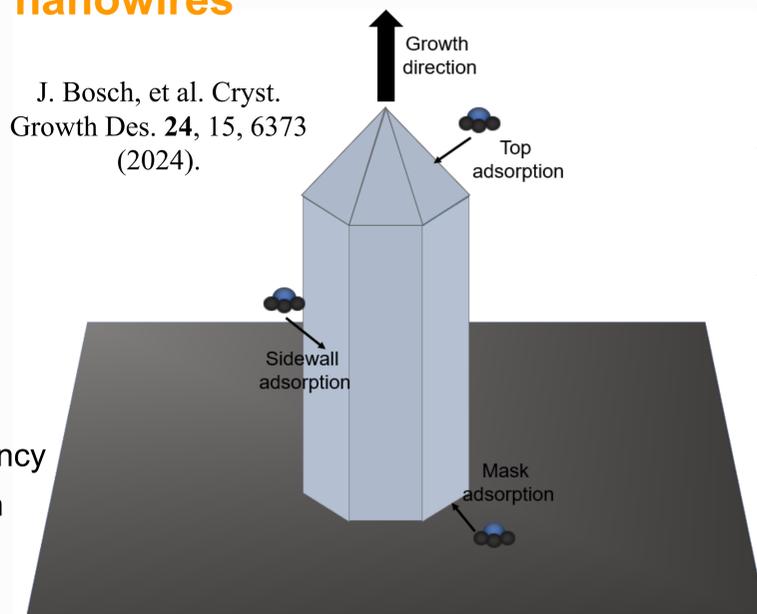
Introduction: GaN nanowires

Applications:

- LEDs
- Laser
- Sensors
- High-frequency devices
- Water splitting

Challenges:

- Defect-prone substrates
- Achieve high light efficiency
- Improve strain relaxation



Sample growth:

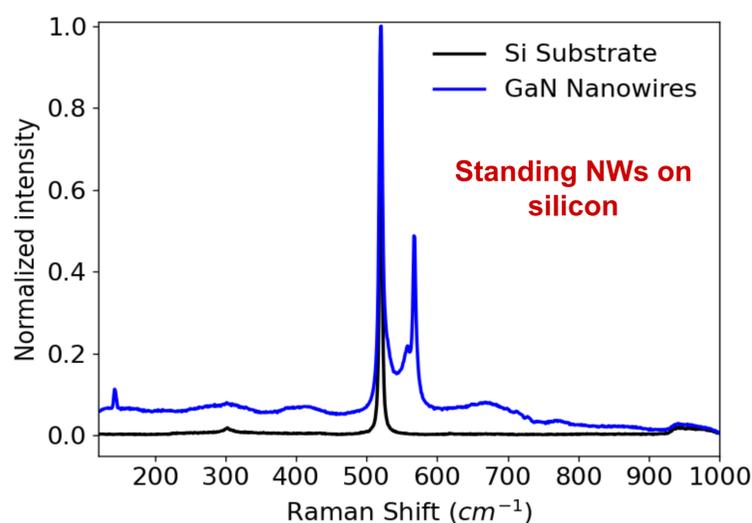
Metalorganic Vapor-Phase Epitaxy (MOVPE) on a masked GaN/sapphire template.

- The GaN template is Ga polar. 30 nm thick SiN_x layer mask patterned by displacement Talbot lithography.
- Hexagonal array of openings. 300 nm diameter and 1.5 μm pitch.

Open question: Are GaN nanowires suitable for water splitting and quantum sensors?

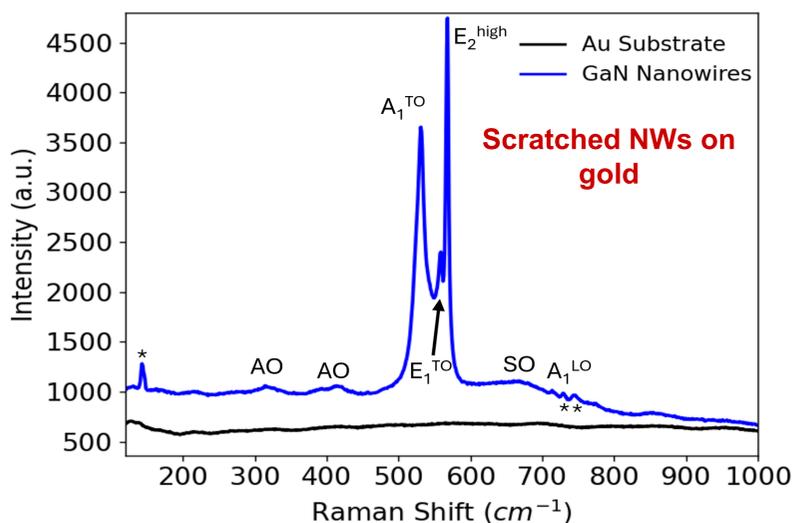
Approach: Growth and optical-electronic properties through a combination of imaging and spectroscopic techniques for possible Water splitting applications.

Results:

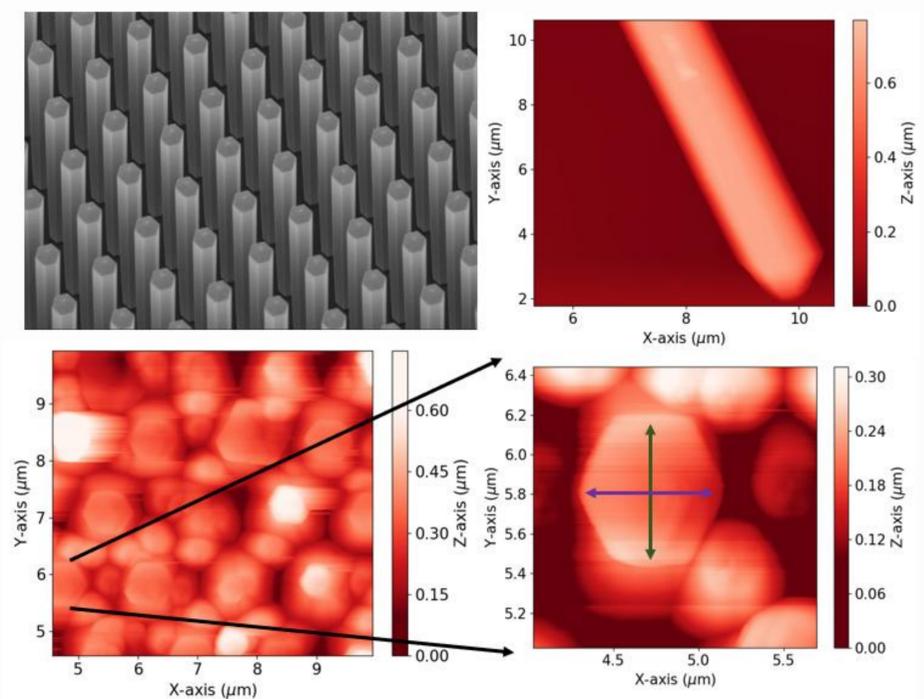


Mode	Energy (cm ⁻¹)
Acoustic Optical (AO)	316
Acoustic Optical (AO)	415
A ₁ ^{TO}	530
E ₁ ^{TO}	556
E ₁ ^{high}	567
Surface Optical (SO)	674
A ₁ ^{LO}	715

Liu, H.-L. *et al. Chem. Phys. Lett.* **345**, 245–251 (2001).



Raman modes with asterisks (*) match with growth precursors of the MOVPE (trimethylgallium, ammonia, silane...)



Average **transverse (x-axis)** diameter of ~735.7 nm and a **vertical (y-axis)** diameter of ~686 nm

Conclusions and Perspectives (work in progress)

Conclusions:

- Preliminary study on GaN nanowires for water splitting and sensor applications
- Raman spectroscopy confirms the presence of modes typical of GaN Nanowires, in particular the SO mode at 674 cm⁻¹
- SEM and AFM imaging provided preliminary characterization of the nanowires
- Imaging in scratched regions allowed for an estimation of NWs diameter

The one-dimensional geometry enhances light absorption efficiency, while high surface-to-volume ratio improves detection sensitivity and response times, making them ideal for water splitting.

Perspectives (work in progress): improved imaging & spectroscopy

- Kelvin probe force microscopy (KPFM)
- Scanning tunnelling microscopy (STM)
- Electron paramagnetic resonance spectroscopy (EPR)
- Raman spectrum vs. Magnetic field, current...

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