HOMO-EPITAXY OF LITHIUM NIOBATE THIN FILMS SYNTHETISED BY PLD

Solmates Webinar | 22 October 2020

LETI AND SOLMATES COLLABORATION

CONTEXT

- **State of the art for RF filters:**
  - SAW devices
    - Made on piezoelectric $LiNbO_3$ (LN) / $LiTaO_3$ 4 inches wafers
    - Quality: low cost
    - Limit: IDT etching limitations on 4 inches → cannot address above 2GHz
  - BAW devices
    - Made on silicon wafers with piezoelectric layers (AlN)
    - Quality: can address high frequencies (2 to 10 GHz)
    - Limit: high cost (require Bragg-mirror for SMR or substrate etching for FBAR)

- **Why LN thin films?**
  - For SAW : High frequency for low cost
  - For BAW : Towards 5GHz for 5G band

WHY IS PLD ATTRACTIVE ?

- **RF application requirements**
  - High crystalline layer
  - Stoichiometric
  - Thickness control

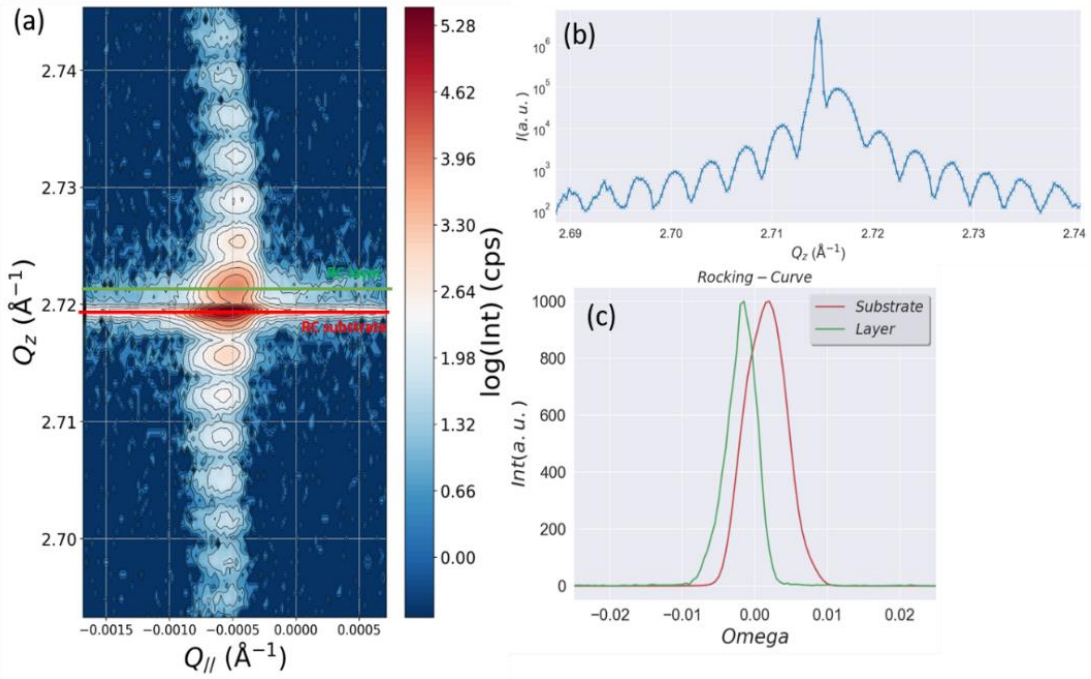
- **Cost**
  - Cheaper than using mono-crystalline substrates
  - Can be included in an industrial flow on Si substartes

HOMO-EPITAXY OF $LiNbO_3$

- **Samples presentation**
  - 4 inches mono-crystallines $LiNbO_3$ substrates with 3 different crystal-cuts: X, Y and Z-cut
  - Deposition of 200 nm-thick $LiNbO_3$ layer

CRYSTALLINE PROPERTIES

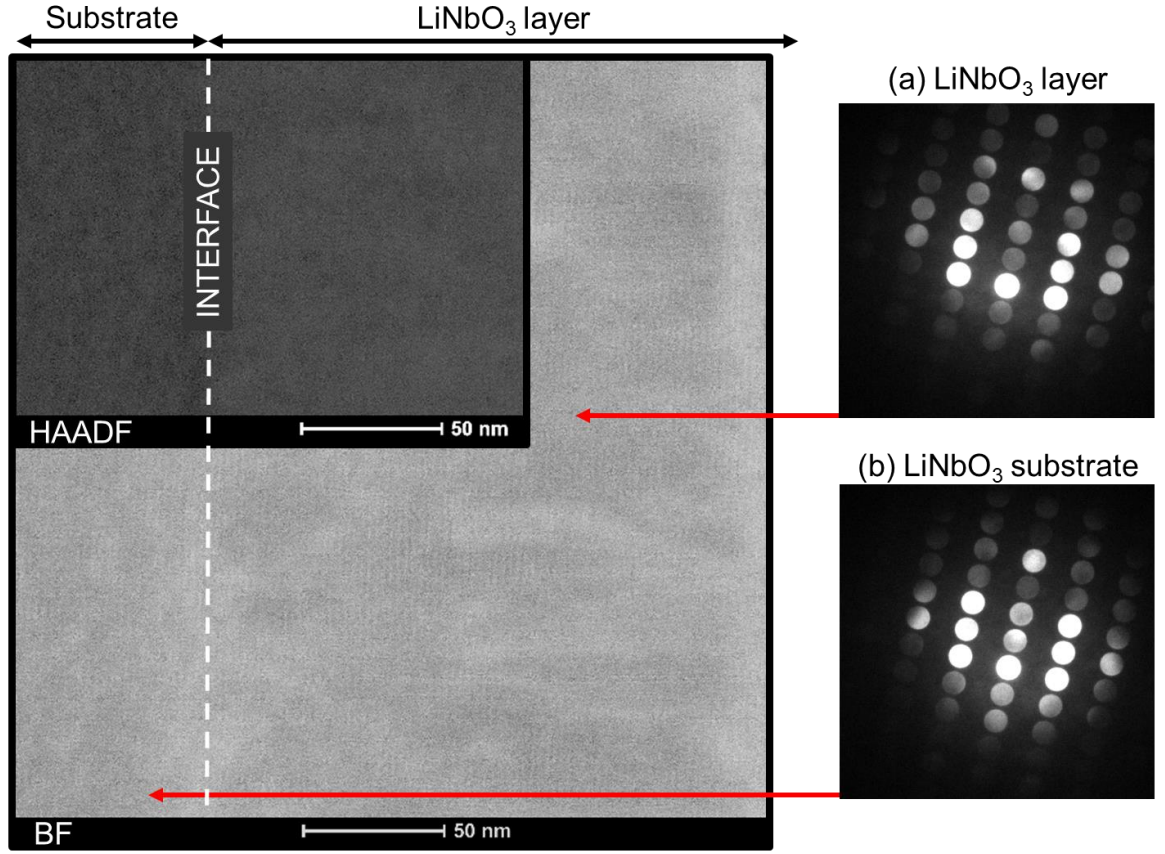
X-RAY DIFFRACTION



Rocking Curve Full Width at Half Maximum (arcsec)			
Sample	**LN X-cut**	**LN Y-cut**	**LN Z-cut**
Layer	13	25	15
Substrate	12	26	17

Cristalline structure of the layer similar to the substrate

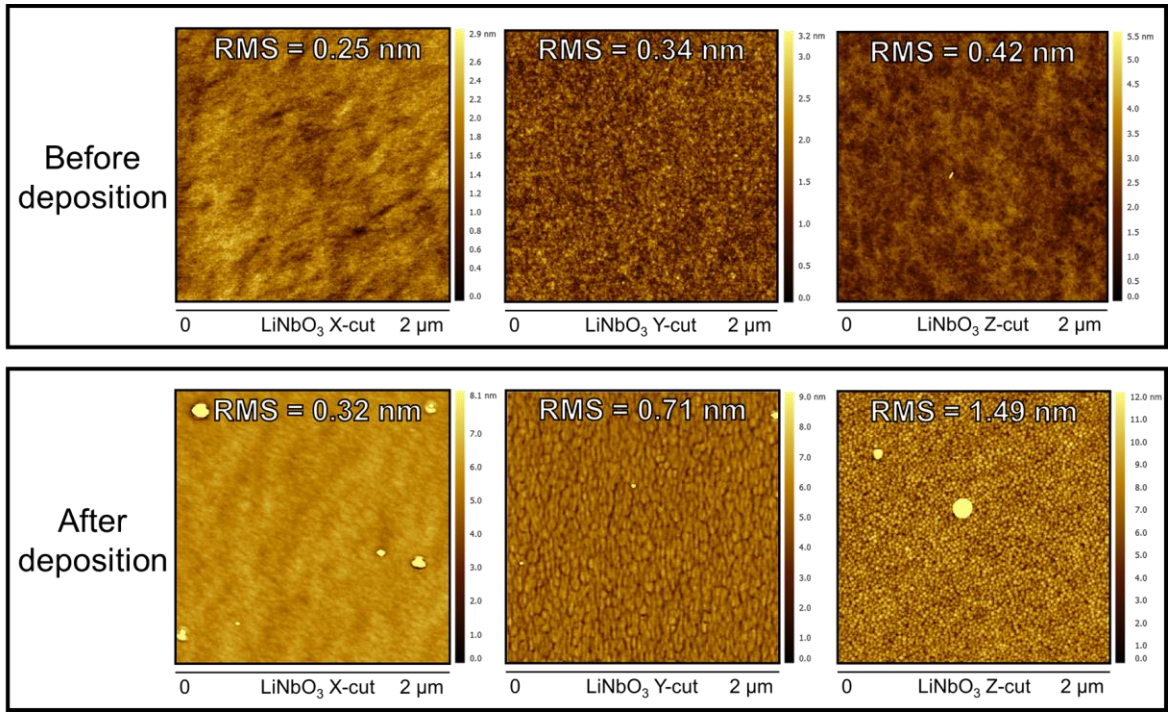
TRANSMITTED ELECTRONS MICROSCOPY



Interface substrate/layer defects-free

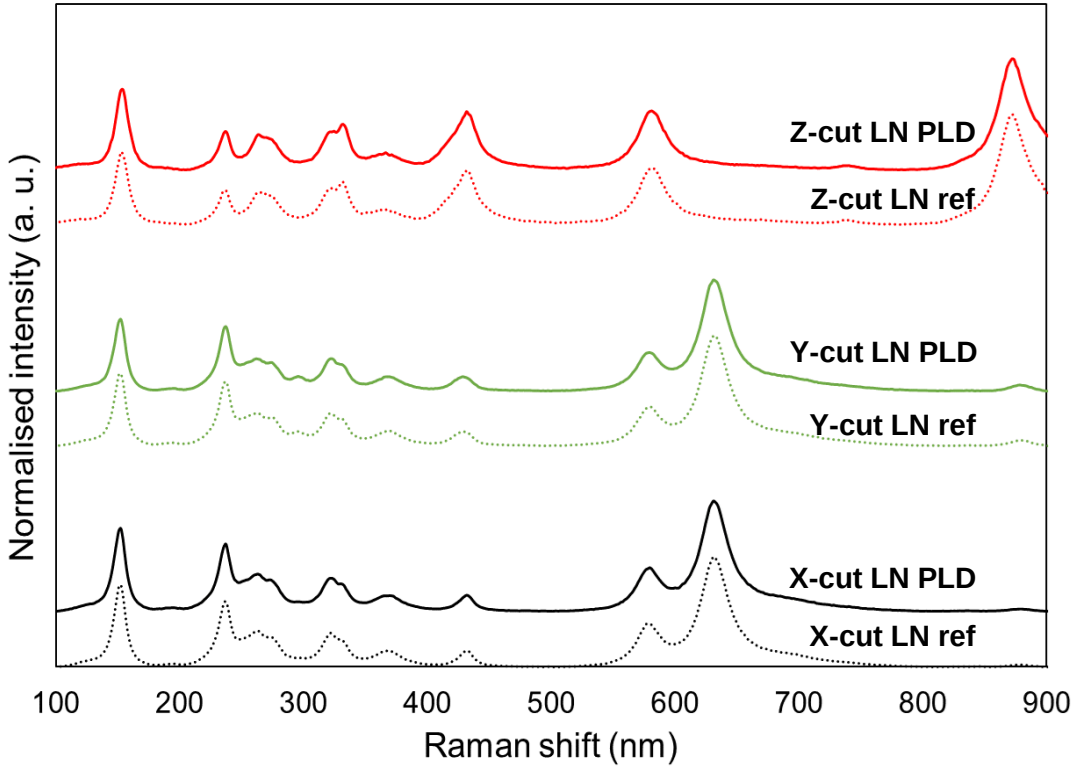
MICROSTRUCTURAL PROPERTIES

AFM



Smooth surfaces with few droplets

RAMAN SPECTROSCOPY



No intensity modifications → low roughness

No major peak shift → low defects

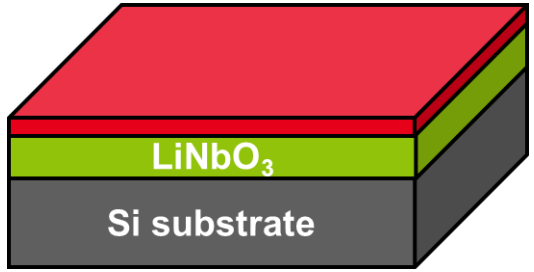
No peak added/subtracted → close stoichiometry

LONG TERM PERSPECTIVES

PERKS OF PLD IN SAW TECHNOLOGY

From mono-crystalline substrates to silicon

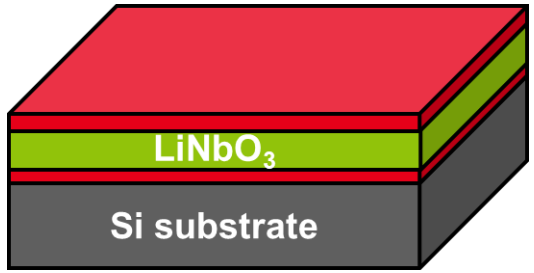
- **Costs reduced**
  - Process on Si substrate
  - Fast fabrication time
  - Large substrate's size
- **Functional under-layer**
- **Thickness control**



PERKS OF PLD IN BAW TECHNOLOGY

RF filters for high frequency above 5 GHz

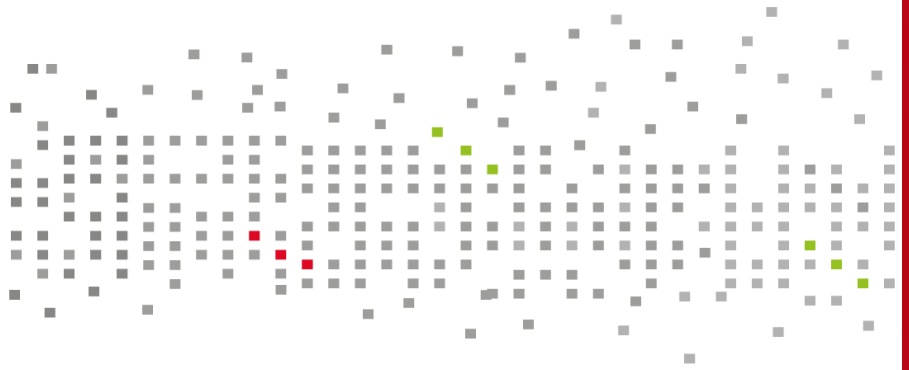
- **Costs reduced**
- **High frequency RF filters with BAW**
- **Entire stack by PLD**
  - Bottom electrode / Piezo layer / Top electrode



LETI AND SOLMATES COLLABORATION

- **$LiNbO_3$ growth**
  - Transfer Solmates $LiNbO_3$ process to LETI
  - Improve growth conditions
  - Goal: demonstrate high-quality $LiNbO_3$ layers on large substrates
- **RF Filters fabrication**
  - Use LETI's state-of-the-art semiconductor silicon fab for high precision manufacturing
  - Goal: demonstrate high-performance RF filter devices using PLD-grown $LiNbO_3$
- **Installation of the first Solmates 200/300 mm bridge tool**
  - Start-up for early 2021

THANK YOU FOR YOUR ATTENTION



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