Self-Assembled Barium Titanate Nanoscale Films by Molecular Beam Epitaxy

Student: Tim Morgan Degree: Ph. D., May 2018
Major Professor: Dr. Greg Salamo

UNIVERSITY OF ARKANSAS
Graduate School & International Education
Microelectronics-Photonics

Nanoscience & Engineering

Background/Relevance

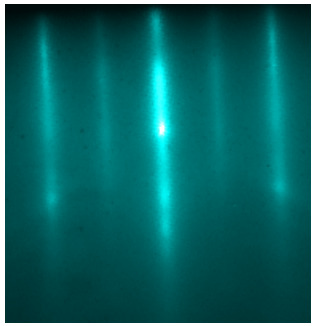
- Barium titanate (BTO) is a ferroelectric material with giant polarization, dielectric constant and surface charge and tunable with electric field, strain, light and composition.
- BTO has no native growth window since no constituents are volatile.

Innovation

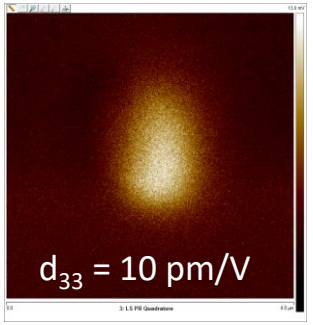
- Approach to locking in stoichiometry is novel and opens up an easier way to grow BTO.
- Co-deposition reduces growth time in half with less calibration time
- Highest d_{33} values of BTO reported by PFM

Approach

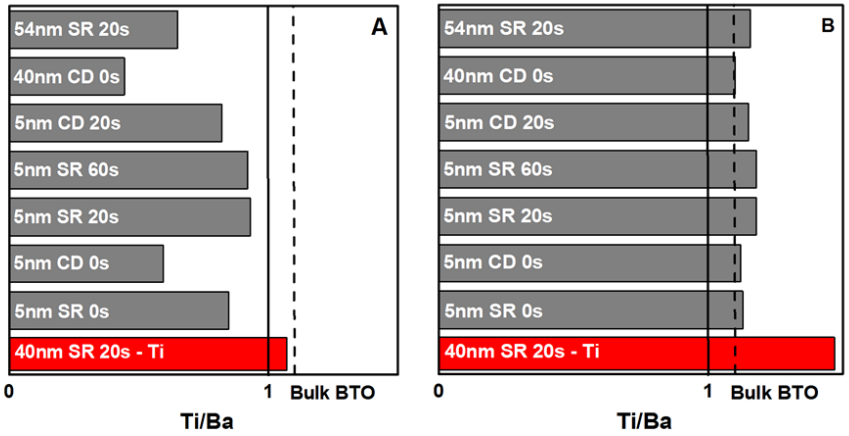
- Use Molecular Beam Epitaxy (MBE) to grow films barium rich in both shuttered RHEED & co-deposited methods.
- Measure strength of ferroelectricity using piezoforce microscopy



RHEED streaks monitored reveal the stoichiometry in real time



Key Results



✓ Stoichiometry self-limits when excess barium provided

Conclusions

- Excess barium self-limits the stoichiometry of barium titanate
- Barium titanate self-assembles when grown using co-deposition with excess barium
- Higher piezoelectric coefficients of barium titanate are measured after solvent cleaning

Future Work

- Investigate defects and growth mechanisms using XTEM
- Investigate ferroelectric properties of single monolayer of BTO

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