INTRODUCTION

Motivation for RE-As Nanocomposites

- Integrate RE-As nanoparticles to enhance device performance:
  - Enhanced tunnel junctions
  - Multijunction solar cells
  - VCSELs
  - Thermoelectrics
  - Photomixers
- Photoconductive materials

Applications for Terahertz Sources

- THz (100GHz – 10THz) in the molecular fingerprint region
- Health and medical:
  - Noninvasive testing/diagnosis
  - Disease biomarker detection
  - Medical imaging
- Security, safety, environmental:
  - Concealed weapon detection
  - Drug, chemical, explosives ID
- Manufacturing:
  - Quality control in production lines
  - Chemical leak/spill detection

GOALS

- Explore phonon scattering effects from nanoparticles and interfaces in LuAs:InGaAs superlattices under different growth conditions.
- Facilitate the material growth and device design.

EXPERIMENT

RE-As Growth on III-Vs Materials

RE-As nanoparticles
- Rocksalt crystal structure
- Continuous arsenic sublattice
- Embedded growth mode
- Exposed material seeds overgrowth
- Monolayer (ML) deposition determined from growth rates of films

X-TEM Study of Growth Enhancement

Improved Structural Quality: AFM & RHEED

Experimental Setup and Coherent Acoustic Phonon Generation

RESULTS AND DISCUSSION

Phonon Lifetime under Different Growth Conditions

SUMMARY AND FUTURE WORK

Summary

- Smooth periodic interfaces scatter coherent acoustic phonons stronger than irregular interfaces.

Future Work

- Investigate interface effects on the phonon scatterings.
- Explore the influences of different RE-As nanoparticles on phonon scattering.

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REFERENCES