

Relevant Table of Contents

Title: III-V Heterostructures for Electronic/Photonic Applications

1. Introduction

- 1.1. Context and motivation of III-V heterostructures
- 1.2. Brief overview of III-V materials (GaAs, InP, GaN, etc.)
- 1.3. Definition of a heterostructure and its relevance to electronics and photonics

2. Fundamental Properties of III-V Materials

- 2.1. Crystal structure, lattice constants, and bonding types
- 2.2. Bandgap, carrier mobility, and transport mechanisms
- 2.3. Strain, deformation, epitaxial layers, and strain effects

3. Growth and Fabrication of III-V Heterostructures

- 3.1. Epitaxial growth methods (MBE, MOCVD)
- 3.2. Lattice mismatch management and interface defect control
- 3.3. Characterization techniques (TEM, PL, micro-cathodoluminescence)

4. Design of Heterostructures for Electronics

- 4.1. Heterojunctions and energy band engineering
- 4.2. High-mobility transistors (HEMT, HBT) and heterojunction diodes
- 4.3. Silicon integration and related challenges (e.g. III-V/Si systems)

5. Design of Heterostructures for Photonics

- 5.1. Light-emitting diodes and III-V heterostructure lasers
- 5.2. Photodetectors and III-V multijunction solar cells
- 5.3. Photonic integration – heterogeneous photonic integrated circuits (III-V + Si)

6. Advanced Nanostructures and Heterostructures

- 6.1. Quantum wells, quantum dots, and superlattices in III-V materials
- 6.2. III-V nanowires and one-dimensional heterostructures
- 6.3. Heterostructures based on 2D or hybrid materials (e.g. III-V/Si semimetal systems)

7. Challenges and Perspectives

- 7.1. Defect management, reliability, and fabrication costs
- 7.2. CMOS compatibility, silicon integration, and mass production
- 7.3. Future research directions: extreme band-engineering, multi-component materials, emerging applications

8. Conclusion

- 8.1. Summary of the main advantages of III-V heterostructures in electronics and photonics
- 8.2. Technological and industrial impacts
- 8.3. Recommendations for research and development

Appendices

- List of abbreviations
- Comparative tables of III-V materials
- Glossary of technical terms