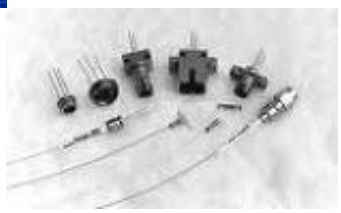
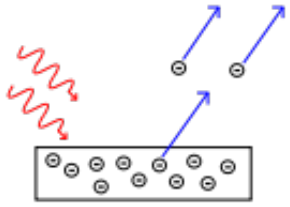
Computational Optoelectronics Course



This course teaches the students the basic principles for the operation of solar cells, light-emitting diodes, photodetectors and VCSELS. For some of these devices, numerical implementation details are given and source codes are provided together with simulation examples. The outline of topics covered is as follows:

1. Quantum Mechanics Review



* Basics of Quantum Mechanics

* Bound States and Open Systems

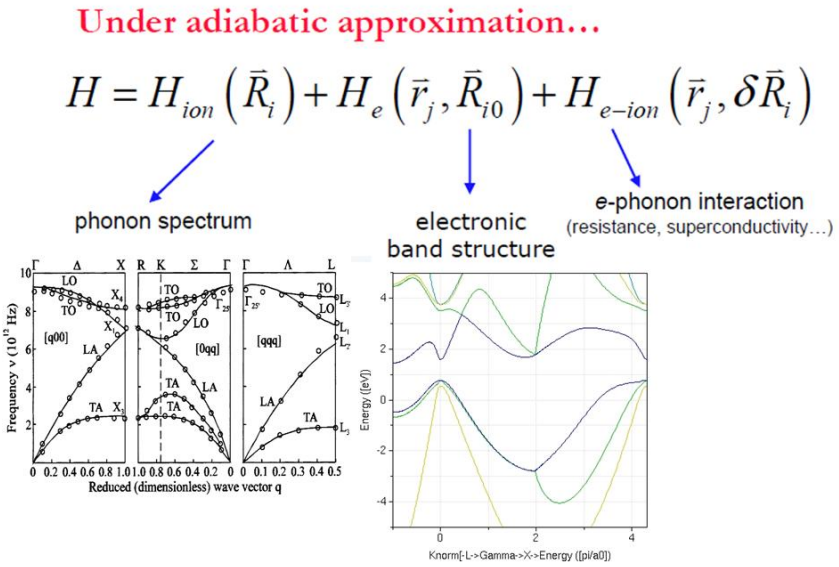
* Tsu-Esaki Formula Derivation

* Quantum Wells, Heterostructures and Superlattices

* Bound States Calculation Lab - Fortran Code

* Piece-Wise Constant Potential Barrier Tool MATLAB Code

2. Band Structure Calculation



* Band Structure Calculation: General Considerations

* Empirical Pseudopotential Method Description

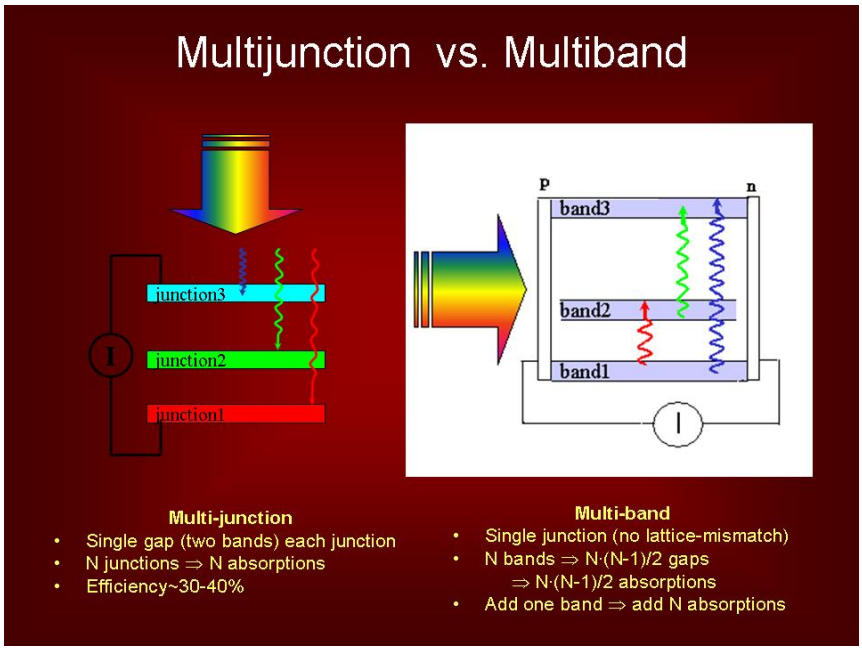
* Tutorial on Semi-empirical Band Structure Methods

* Empirical Pseudopotential Method: Theory and Implementation

* Description of the K.P Method for Band Structure Calculation

* Tight-Binding Band Structure Calculation Method

3. Solar Cells



* Renewable Energy Sources

* Solar Cells Operation and Modeling

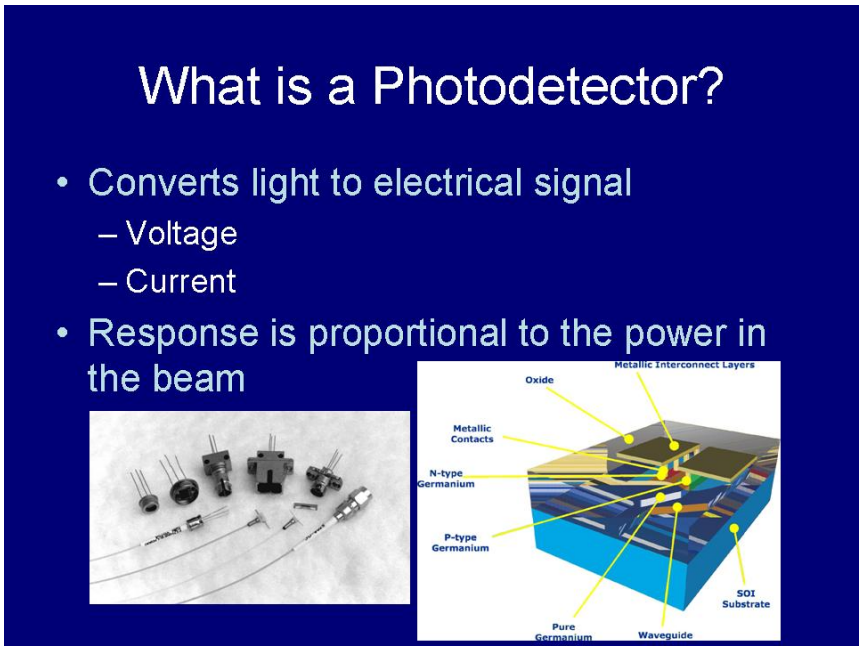
* Crystalline Silicon Solar Cell Program

* Optimize Solar Cells

* Solar Cells Numerical Solution

* SILVACO Simulation of Solar Cells

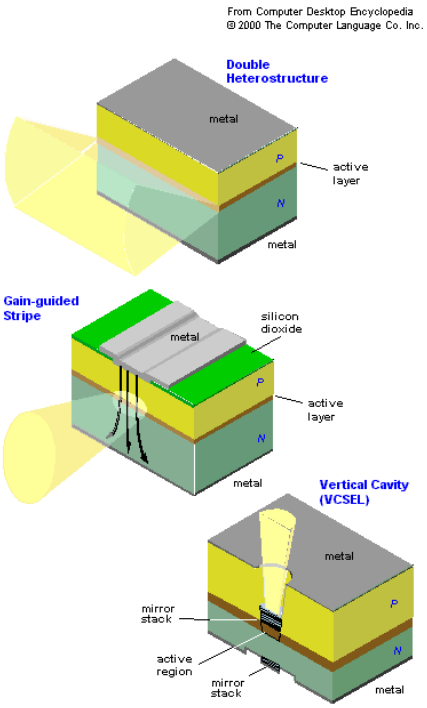
4. Photodetectors



* Physical and Mathematical Description of the Operation of Photodetectors

5. Light Emitting Diodes

6. Lasers



Suggested Reading:

* D. K. Ferry. (2001). *Quantum Mechanics: An Introduction for Device Physicists and Electrical Engineers*. 2nd ed. Bristol (UK): Institute of Physics Publishing.

* Reading Material for Introductory Concepts in Quantum Mechanics

* Quantum Mechanics: Postulates

* Reading Material: Time Independent Schrodinger Wave Equation (TISWE)

* Double Barrier Case

* Reading Material: Esaki Diode

* Tutorial on Semi-empirical Band Structure Methods