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Expressions for Critical Thickness

2.7.5 Strain Symmetric Structures and Virtual Substrates 2.7.6 Band Offsets and Band Lineup; 2.7.7 Electronic Properties of SiGe/Si Heterostructures; 2.8 Direct Gap: Ge/SiGeSn Heterojunctions; 2.8.1 Structures; 2.8.2 Band Edges and Band Lineup; Problems; References; Suggested Readings; 3 Quantum Structures; 3.1 Introduction; 3.2 Quantum Wells; 3.2.1 Condition for Quantum Confinement; 3.2.2 A Representative Structure; 3.2.3 Simplified Energy Levels; 3.2.4 Density-of-States in Two Dimensions; 3.2.5 Finite Quantum Well; 3.2.6 Refined Methods; 3.2.7 Different Band Alignments

3.3 Quantum Wires and Dots 3.3.1 Subbands and DOS in Quantum Wires; 3.3.2 Quantum Dots; 3.4 Superlattices; 3.5 Si-Based Quantum Structures; 3.5.1 Electron Subband Structure; 3.5.2 Hole Subbands; 3.5.3 Quantum Wells and Barriers; 3.6 Effect of Electric Field; Problems; References; Suggested Readings; 4 Optical Processes; 4.1 Introduction; 4.2 Optical Constants; 4.3 Basic Concepts; 4.3.1 Absorption and Emission; 4.3.2 Absorption and Emission Rates; 4.4 Absorption Processes in Semiconductors; 4.5 Fundamental Absorption in Direct Gap; 4.5.1 Conservation Laws

4.5.2 Calculation of Absorption Coefficient 4.6 Fundamental Absorption in Indirect Gap; 4.6.1 Theory of Absorption; 4.6.2 Absorption Spectra in Si; 4.6.3 Absorption Spectra in Ge; 4.7 Absorption and Gain; 4.8 Intervalence Band Absorption; 4.9 Free-carrier Absorption; 4.10 Recombination and Luminescence; 4.10.1 Luminescence Lifetime; 4.10.2 Carrier Lifetime: Dependence on Carrier Density; 4.10.3 Absorption and Recombination; 4.10.4 Microscopic Theory of Recombination; 4.11 Nonradiative Recombination; 4.11.1 Recombination via Traps; 4.11.2 Auger Recombination; 4.11.3 Surface Recombination

4.11.4 Recombination of Complexes

Sommario/riassunto

The creation of affordable high speed optical communications using standard semiconductor manufacturing technology is a principal aim of silicon photonics research. This would involve replacing copper connections with optical fibres or waveguides, and electrons with photons. With applications such as telecommunications and information processing, light detection, spectroscopy, holography and robotics, silicon photonics has the potential to revolutionise electronic-only systems. Providing an overview of the physics, technology and device operation of photonic devices using exclusively silicon