The band structure of a chain of periodically ordered different quantum dots

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Abstract

The paper introduces a model for a superlattice comprising periodically arranged quantum dots (QDs) and proposes a method for calculating the energy spectrum. This theory was applied to a chain of QDs. The study employed the effective mass approximation and solved the Schrödinger equation using the tight-binding model and nearest neighbor approximation. The energy spectra of electrons were determined as functions of the wave vector, and the theory facilitated the calculation of dispersion dependencies and bandwidths. The presence of different QDs resulted in the subdivision of the mini-zone into upper and lower zones. It was demonstrated and analyzed that the width of the upper zones consistently exceeds that of the lower ones. Furthermore, when the QDs possess identical sizes and materials, no forbidden zone is observed. © 2024 Elsevier B.V.

Author keywords

Band width; Energy spectrum; Quantum dots of different sizes; Quantum dots of different types; Upper and lower zone

Indexed keywords

Engineering controlled terms

Nanocrystals

Engineering uncontrolled terms

Band width; Different sizes; Effective mass approximation; Energy spectrum; Nearest neighbor approximations; Quantum dot of different size; Quantum dot of different type; Tight-binding modeling; Upper and low zone; Wave vector

Engineering main heading

Semiconductor quantum dots

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Abstract

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