October 18th, 2019

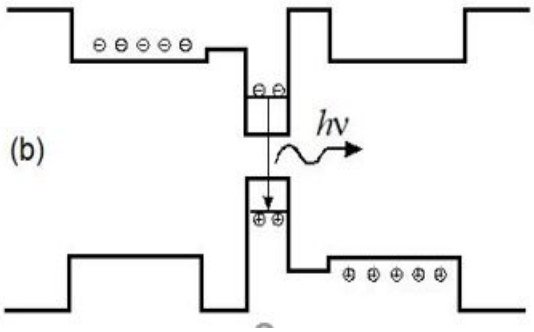
Semiconductor Quantum Dot Lasers with Asymmetric Barrier Layers

John L Monk III and Levon Asryan

Department of Materials Science and Engineering, Virginia Tech

Abstract

Semiconductor lasers, first developed in the early 1960's, use the principles of semiconductor PN junctions to achieve lasing, and have been used in communication and medical applications since their inception. Quantum dot lasers present an advanced type of semiconductor laser. However, even in conventional quantum dot lasers, there is parasitic recombination of electron-hole pairs outside of the active region that adversely affects the laser characteristics. Parasitic recombination can be stopped with the introduction of asymmetric barrier layers. Rate equations for electrons and holes in and outside of the quantum dots and emitted photons are used to model the behavior of the semiconductor quantum dot laser with asymmetric barrier layers. The optimal conditions for semiconductor quantum dot lasers with asymmetric barrier layers are calculated, in order to maximize their modulation bandwidth. This includes finding the optimal values of the dc component of the pump current, quantum dot surface density and size fluctuations, and cavity length.



Energy band diagram for Semiconductor Quantum Dot Laser with Asymmetric Barrier Layers

Biography

John (Jack) Monk completed his undergraduate studies in Physics at Virginia Tech in Spring 2018. He began his graduate studies here in Fall 2018 and is expected to graduate in Spring 2020 with his Masters of Science. He is currently working with Professor Asryan on semiconductor quantum dot lasers.