

**Vertical Coupling in Multiple Stacks Quantum Dot Semiconductor Optical Amplifiers**

**Authors:** Omar Qasaimeh

**Abstract:** The characteristics of vertically coupled multiple stacks quantum-dot (QD) semiconductor optical amplifiers (SOAs) are studied taking into account the effect of carrier coupling between adjacent stacks. We find that QD-SOAs that consist of a few numbers of stacks provide higher optical gain at lower applied current. Our analysis shows that the optical gain of the amplifier can be considerably enhanced due to short tunnelling lifetimes between adjacent stacks. Also, our analysis reveals that short coupling lifetimes can significantly reduce the transparency current and improve the uniformity of the active region since the net coupling rate is a linear function of the injection rate. Long coupling lifetime, on the other hand, produces non-linear and non-uniform coupling rates, which reduce the optical gain and increase the transparency current of the amplifier. We also find that the degradation in the unsaturated optical gain due to long coupling lifetimes is more severe in p-type doped QD-SOA compared with un-doped QD-SOA.