

Progress on Vertical-Cavity Surface-Emitting Lasers

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The vertical-cavity surface-emitting laser (VCSEL) has undergone intense laboratory development during the last decade and has recently transitioned to the commercial sector. The commercial success of VCSELs stems from the use of traditional microelectronic fabrication technologies for inexpensive manufacturing and the growing demand for fiber-optic-network components.

We will first outline the historical evolution of VCSELs and describe the two common means of fabricating apertures to confine the current within the laser cavity. Ion implantation was the first method to be demonstrated and is prevalent in commercial devices. The method of selective oxidation of AlAs was introduced more recently and has yielded VCSELs with improved performance. Specifically, selectively oxidized VCSELs have exhibited record low threshold currents, high efficiencies, and high modulation bandwidths.

VCSELs that emit light into a single optical mode are of interest for many applications, such as data transmission in single-mode fibers, pump lasers for fiber amplifiers, and laser printing. The maximum power emitted by a monolithic electrically pumped VCSEL into a single mode has been limited to about 5 mW for several years. We will discuss various attempts that have been made to improve the single-mode-output power from VCSELs.

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