Non-850nm Vertical Cavity Laser Applications and Manufacturing Technology

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Abstract

Vertical-Cavity Surface-Emitting Lasers (VCSELs) based upon the GaAs/AlGaAs material system emitting at 850nm have been the standard optical source for glass fiber optic-based data communication links since the mid-1990s, and have recently found widespread use in optical computer mice. Together, these two applications make up the vast majority of VCSEL based products shipped to date. The commercial success of 850nm based VCSEL technology is due in large part to the maturity of the materials system and processing technology. There do, however, exist other compelling opportunities for VCSELs operating outside this wavelength range that have yet to be widely commercialized, either due to the immaturity of the target markets, the technology, or both.

This work will detail the efforts at Vixar to address several of these alternative markets, namely:

1) AlGaInP based 670nm VCSELs for sensor, biomedical, and plastic fiber applications,
2) AlGaAs based 795nm and 895nm VCSELs for atomic frequency references, and
3) Strained InGaAs on InP 1850nm VCSELs for neural stimulation.

In addition to design and performance particulars, we will emphasize some of the processing challenges unique to each wavelength range including epitaxial growth, non-epitaxial dielectric mirrors, planarization, and uniform lateral oxidation of 4” wafer substrates.

As is typical, each application has associated with it a unique set of performance specifications, some of which have proven very challenging. In particular, we will report on our successes in achieving high temperature operation of visible VCSELs and narrow linewidth, polarization stable NIR VCSELs. Other topics to be addressed include reliability in dry and humid environments, wafer-level test, failure modes related to device encapsulation in non-hermetic PLCC packaging, and precision die placement in chip-on-board array packaging.