Fabrication of Surface Emitting Devices Using Wafer Bonding Technology

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ABSTRACT

The performance of long wavelength VCSELs still lags behind their shorter wavelength counterparts such as GaAs /AlGaAs and GaAs/InGaAs VESELs. One severe problem for long wavelength VCSELs is their lack of good native Bragg mirrors: InGaAsP/InP mirrors grown on InP-based active layers have too small an index difference and rather poor thermal properties compared to GaAs/AlGaAs Bragg mirror. The introduction of wafer-fusion GaAs/AlAs Bragg mirrors has proved to be a very effective approach to solve the mirror problems for long wavelength VCSELs, and much improvement has been made using such wafer-fusion bragg mirrors. In this thesis, we have discussed the surface treatment and electrical properties of the fusion interface at high temperature and under applied uniaxial pressure to form robust chemical bonds. And use intermediate layer bonding by a low-temperature and short time wafer-fusion process to bond the metal-mirror substrate to optoelectronic device, such as high brightness AlGaInP LED and VCSELs. The metal mirror consists of Au and AuBe. The substrate is Si wafer. The metallic interlayer can be not only as an adhesive layer, but also as the reflective mirror and ohmic contact layer. The Si substrate provides a good heat sink. It demonstrated the performance and reliability of wafer-bonded AlGaInP /mirror/ Si light-emitting diodes.

Keywords : wafer bonding technology ; mirror substrate ; VCSEL ; LED ; Intermediate Layer Bonding

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