

Investigation of cavity mode and excitonic transition in an InGaAs/GaAs/AlGaAs vertical-cavity surface emitting laser structure by variable-temperature photoluminescence, reflectance and photomodulated reflectance

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Variable-temperature photoluminescence (PL), reflectance and photomodulated reflectance (PR) have been used to study an InGaAs/GaAs/AlGaAs vertical-cavity surface emitting laser (VCSEL) structure. PL and PR spectra have been recorded at different temperatures between 80 K and 300 K. by comparing with PR and reflectance results of an etched sample, we find that variable-temperature PL is a powerful noninvasive tool to measure accurate the quantum well transition and the cavity mode alignment. The measured results are found to be in good agreement with calculated results using a six-band $k \cdot p$ model and a Johns matrix approach.