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Scalar and vectorial approaches to cavity modes of the GaAs-based 1.3-μm oxide-confined edge emitting diode laser

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Abstract

The modelling of optical fields within cavities of GaAs-based oxide-confined edge-emitting diode lasers is analysed treating the 1.3-μm InGaAs/GaAs quantum-well laser as an example of a typical device. Usability of two different optical approaches is compared. While in the first approach, based on the scalar wave simplification, optical fields within laser resonators are found to be composed of the TE modes, an alternative, more precise vectorial approach leads to the hybrid modes: EH and HE. Advantages and disadvantages of both methods are discussed and their validity limits in determination of mode intensities are compared. Simplified scalar approaches have often happened to be surprisingly exact, except for their weaker guidance occurring for higher-order modes, narrower aperture widths and/or thinner oxidation layers, when more exact but also more time-consuming vectorial approaches should be exclusively used.