184. Title: Mode structure of a quantum cascade laser

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Abstract: We analyze the mode structure of a quantum cascade laser (QCL) cavity considering the surface plasmon-polariton modes and familiar modes of hollow resonator jointly, within a single model. We present a comprehensive mode structure analysis of the laser cavity, varying its geometric parameters and free electron concentration inside cavity layers within a wide range. Our analysis covers, in particular, the cases of metal-insulator-metal and insulator-metal-insulator waveguides. We discuss the phenomenon of negative dispersion for eigenmodes in detail and explain the nature of this phenomenon. We specify a waveguide parameters domain in which negative dispersion exists. The mode structure of QCL cavity is considered in the case of the anisotropic electrical properties of the waveguide materials. We show that anisotropy of the waveguide core results in propagation of Langmuir modes that are degenerated in the case of the isotropic core. Comparative analysis of optical losses due to free carrier absorption is presented for different modes within the frequency range from terahertz to ultraviolet frequencies.