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Title:Tunable emission in THz quantum cascade lasers
Authors:Vitiello, Miriam Serena (1); Tredicucci, Alessandro (2)
Author affiliation:(1) Istituto di Fisica Applicata Nello Carrara-CNR, Sesto Fiorentino, I-50019, Italy; (2) NEST, Istituto Nanoscienze-CNR, Scuola Normale Superiore, Pisa, I-56127, Italy
Corresponding author:Vitiello, M.S.(miriam.vitiello@sns.it)
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Abstract:The technological solutions and optical configurations employed to tune the emission frequency of quantum cascade lasers (QCLs) operating in the Terahertz range are reviewed. The gain spectrum of THz QCLs can be engineered by quantum design to be broadband over a range even larger than 1 THz, or, alternatively, to be electrically tunable, for instance exploiting the Stark shift of the lasing transition. Fabry-Perot lasers can then display very ample multimode spectra, but wide, though discontinuous and unpredictable, tunability through mode hopping can also be achieved. For reliable and repeatable single-mode tuning, QCL emitters based on external cavities can be realized using either a movable mirror to control the cavity length or a rotating grating for wavelength dependent feedback. First-order and second-order distributed feedback (DFB) THz QCLs also provide stable single-mode emission, whose frequency can be tuned by temperature and current, though usually on a more limited range of only a few GHz. It has been recently shown, however, that second-order THz DFB lasers can be coupled to an external microcavity, exploiting the anti-crossing of the respective eigenfrequencies to achieve wider tuning ranges by mechanically changing the size of the external microcavity. As an alternative, if fabricated in a narrow ∼λ3) ridge configuration, double-metal THz DFB lasers represent an ideal device where to manipulate the lateral size of the lasing mode via electro-mechanical components. In this way, a new and robust method for wide and continuous tuning of the laser emission has been recently demonstrated, displaying a record large bandwidth of over 330 GHz.
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