487
Accession number:WOS:000306995000024
Title:Efficient power extraction in surface-emitting semiconductor lasers using graded photonic heterostructures
Authors:Xu, G.Y. (1); Colombelli, R. (1); Khanna, S.P. (2); Belarouci, A. (3); Letartre, X. (3); Li, L.H. (2); Linfield, E.H. (2); Davies, A.G. (2); Beere, H.E. (4); Ritchie, D.A. (4)
Author affiliation: (1) Univ Paris 11, Inst Elect Fondamentale, CNRS, UMR8622, F-91405 Orsay, France; (2) Univ Leeds, Sch Elect & Elect Engn, Leeds LS2 9JT, W Yorkshire, England; (3) Univ Lyon, INL, CNRS, Ecole Cent Lyon,UMR 5270, F-69134 Ecully, France; (4) Univ Cambridge, Cavendish Lab, Cambridge CB3 0HE, England
Source title:NATURE COMMUNICATIONS
Abbreviated source title:
Volume:3
Issue date:JUL 2012
Pages:952
Language:English
ISSN:2041-1723
Document type:Article
Publisher:
Abstract:Symmetric and antisymmetric band-edge modes exist in distributed feedback surface-emitting semiconductor lasers, with the dominant difference being the radiation loss. Devices generally operate on the low-loss antisymmetric modes, although the power extraction efficiency is low. Here we develop graded photonic heterostructures, which localize the symmetric mode in the device centre and confine the antisymmetric modes close to the laser facet. This modal spatial separation is combined with absorbing boundaries to increase the antisymmetric mode loss, and force device operation on the symmetric mode, with elevated radiation efficiency. Application of this concept to terahertz quantum cascade lasers leads to record-high peak-power surface emission (>100 mW) and differential efficiencies (230 mW A(-1)), together with low-divergence, single-lobed emission patterns, and is also applicable to continuous-wave operation. Such flexible tuning of the radiation loss using graded photonic heterostructures, with only a minimal influence on threshold current, is highly desirable for optimizing second-order distributed feedback lasers.
Number of references:42
Main heading:Physics
DOI:10.1038/ncomms1958