485
Accession number:WOS:000307046800011
Title:Quantum-limited frequency fluctuations in a terahertz laser
Authors:Vitiello, M.S. (1); Consolino, L. (1); Bartalini, S. (1); Taschin, A. (1); Tredicucci, A. (2); Inguscio, M. (1); De Natale, P. (1)
Author affiliation: (1) CNR, Ist Nazl Ott, I-50019 Sesto Fiorentino, FI, Italy; (2) CNR, Ist Nanosci, NEST, I-56127 Pisa, Italy
Source title:NATURE PHOTONICS
Abbreviated source title:NAT PHOTONICS
Volume:6
Issue:8
Issue date:AUG 2012
Pages:525-528
Language:English
ISSN:1749-4885
Document type:Article
Publisher:NATURE PUBLISHING GROUP, MACMILLAN BUILDING, 4 CRINAN ST, LONDON N1 9XW, ENGLAND
Abstract:Quantum cascade lasers(1,2) can be considered the primary achievement of electronic band structure engineering, showing how artificial materials can be created through quantum design to have tailor-made properties that are otherwise non-existent in nature. Indeed, quantum cascade lasers can be used as powerful testing grounds of the fundamental physical parameters determined by their quantum nature, including the intrinsic linewidth of laser emission(3), which in such lasers is significantly affected by the optical and thermal photon number generated in the laser cavity. Here, we report experimental evidence of linewidth values approaching the quantum limit(4,5) in far-infrared quantum cascade lasers. Despite the broadening induced by thermal photons, the measured linewidth results narrower than that found in any other semiconductor laser to date. By performing noise measurements with unprecedented sensitivity levels, we highlight the key role of gain medium engineering(6) and demonstrate that properly designed semiconductor-heterostructure lasers can unveil the mechanisms underlying the laser-intrinsic phase noise, revealing the link between device properties and the quantum-limited linewidth.
Number of references:40
Main heading:Optics; Physics
DOI:10.1038/nphoton.2012.145