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Abstract:The terahertz (THz) frequency quantum cascade laser (QCL) is a semiconductor heterostructure laser that has attracted much research interest over the past decade. We report on the high performance of THz QCLs based on a three-well resonant-phonon (RP) depopulation active region (AR) and operating in the frequency range 2.7 THz to 4.0 THz. Devices, processed into surface-plasmon waveguides, lased up to 116K in pulsed mode with threshold current densities as low as 840 Acmsup-2/sup. The effects of the design frequency and laser cavity length on performance are discussed. We also report on the operation of QCLs with reduced AR thicknesses, and show, for the first time, that the AR thickness of RP QCLs processed in a surface plasmon waveguide can be reduced to as little as 5μm. Finally, we demonstrate the use of an electrically tuneable THz QCL, based on a heterogeneous AR, for spectroscopic imaging of the high-explosive pentaerythritol tetranitrate. © 2012 IOP Publishing Ltd.
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