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Title:Threshold current density reduction by utilizing high-AI-composition barriers in 3.7 THz GaAs/Al_xGa_{1-x}As quantum cascade lasers
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Abstract:The temperature dependence of threshold current density (J_{th}) for GaAs/Al_xGa_{1-x}As terahertz quantum cascade lasers (THz-QCLs) with different Al barrier compositions is studied. We achieved a maximum operation temperature (T_{max}) of 143 K for a 3.7 THz QCL by employing a longitudinal-optical (LO) phonon depopulation scheme. High-AI-composition barriers are used for increasing averaged LO-phonon energy. A significant reduction in J_{th} of approximately 30% was obtained by increasing the Al composition from 15 to 35%, when we used the same energy separation of the depopulation stats (E₂₁). T_{max} could be increased by using high-AI-composition structures due to the reduction of thermally-activated LO-phonon scattering.
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Inspec controlled terms:aluminium compounds - current density - gallium arsenide - III-V semiconductors - phonons - quantum cascade lasers - semiconductor quantum wells
Uncontrolled terms:threshold current density reduction - high-AI-composition barriers - terahertz quantum cascade lasers - temperature dependence - maximum operation temperature - longitudinal-optical phonon depopulation scheme - averaged longitudinal-optical-phonon energy - energy separation - depopulation stats - high-AI-composition structures - thermally-activated longitudinal-optical-phonon scattering reduction - frequency 3.7 THz - temperature 143 K - GaAs-Al_xGa_{1-x}As
Inspec classification codes:A4255P Lasing action in semiconductors - A4260B Design of specific laser systems - B4320J Semiconductor lasers
Numerical data indexing:frequency 3.7E+12 Hz;temperature 1.43E+02 K
Chemical indexing:GaAs-AlGaAs/int AlGaAs/int GaAs/int Al/int As/int Ga/int AlGaAs/ss Al/ss As/ss Ga/ss GaAs/bin As/bin Ga/bin
Treatment:Practical (PRA); Experimental (EXP)

Discipline:Physics (A); Electrical/Electronic engineering (B)
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