Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Quantum cascade laser with low threshold and high characteristic temperature $T_0 > 300K$ at ~ 14 μm[1] XUE HUANG, WILLIAM CHARLES, CLAIRE GMACHL, Princeton University, MIRTHE TEAM — High-performance quantum cascade (QC) lasers with wavelength in $4 \sim 12$ μm range are widely used in trace gas sensing. However, lack of high performance for longer wavelength in the $12 \sim 16$ μm range, where exist the strongest absorption lines of BTEX (benzene, toluene, ethylbenzene, and xylenes) and Uranium Hexafluoride, prohibits QC laser applications in sensing these important gases. The QC laser emitting at ~ 14 μm we investigate here is based on a diagonal-transition design. The depletion of the lower laser state is achieved by a one-phonon-continuum scheme instead of the widely used "continuum" lower mini-bands in existing long-wavelength lasers. This scheme reduces LO scattering from the upper laser state, the leakage from the injector and thermal back-filling to the lower laser state, thus attaining population inversion efficiently. The laser shows low threshold (J_{th} =2.4 kA/cm^2 for a 1.97-mm-long laser at room temperature), and a high characteristic temperature T_0 =309K fitted from $J_{th}(T) = J_0 e^{T/T_0}$, which is comparable with the record highest characteristic temperature. The peak power is 1.4W at 80K and 0.25W at 300K.

[1]Work supported in part by MIRTHE (NSF-ERC).

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Date submitted: 17 Nov 2010 Electronic form version 1.4