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**Monolithic Mid-Infrared Photonic Integration of a
Quantum Cascade Laser and a Passive Semiconductor Waveguide**

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Ann Arbor and Princeton University — On-chip integration of
a quantum cascade (QC) laser with a passive semiconductor waveguide
is reported. We use conventional semiconductor processing techniques
to fabricate a QC laser directly coupled to a passive waveguide, where
the unbiased active region and the lower cladding layers of the QC laser
are used as the waveguide. The QC architecture is compatible with this
technique due to the different allowed optical transitions when the QC
structure is biased (for laser operation) and unbiased (for the passive
waveguide). Thus the same epitaxial layers are made to emit light under
bias and not absorb that same light when unbiased. The waveguide
portion of the structure is fabricated by using a selective etch to remove
the top InP cladding layers above the QC active core. We find the effective
refractive index contrast provided by the etch step between the laser and
waveguide to be sufficient for providing optical feedback for the laser.
For our structure, we calculate a laser-waveguide “facet” reflectivity of
about 3% based on a 25% increase in threshold current density compared
to the same laser structure with two cleaved facets.

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Prefer Oral Session
Prefer Poster Session

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