

Photonic Crystal Microcavity Lasers

*A. Scherer, M. Loncar, B. Maune, M. Adams, T. Yoshie
Caltech, Pasadena, CA 91125*

35 word abstract:

By using photonic crystal cavity designs, we have defined ultra-small lasers for optical switching and spectroscopy. Here we describe the design, fabrication, and characterization of these nanocavity lasers.

200 word abstract:

Photonic crystal nanocavities enable the interaction of nonlinear optical material with very high optical field intensities. For example, we have recently developed photonic crystal lasers, with mode volumes of one tenth of a cubic half-wavelength, that permit the introduction of analyte into the peak of the optical field of a lasing mode. Such nanocavity lasers can be used to perform spectroscopic tests on femtoliter volumes of analyte – enabling the optical trapping and interrogation of small particles – and are expected to ultimately lead to single molecule spectroscopy. Metal nanostructures enable the construction of even smaller optical cavities with even higher optical fields. By careful design and fabrication, high quality optical resonators with ultra-small mode volumes have been constructed and optimized to achieve the highest possible optical fields. Here we describe the design, fabrication and characterization of a new class of opto-fluidic devices in which light is concentrated to high fields to efficiently interact with small volumes of material. When combined with nonlinear optical polymers, such photonic crystal nanocavities will lead to very compact optical modulators or tunable filters with high efficiencies and modulation frequencies.