Wavelength Tunable Nanosecond Pulsed Broad-Area Lasers*

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Abstract

Pulsed lasers with pulse durations of nanosecond to millisecond are very important tools for free-space optical communication, LADAR, laser material processing, and optical sensing. Although Q-switched solid-state lasers or gas lasers are currently the most popular light sources for these purposes, pulsed semiconductor lasers have advantages of compactness, accessibility of direct modulation, and inherently large electrical to optical conversion efficiency.

In this paper, we report the experimental results of frequency locking and wavelength tenability of a nanosecond pulsed broad-area semiconductor laser with an external grating. The broad-area laser used in the experiment is a commercially available single stripe laser (Coherent Inc.) with the emission area of $100\times1\ \mu m^2$. At the CW operation mode, the laser has the maximum light output of 1.2 W around the wavelength of 808 nm. We drive the laser with a DEI pulse driver to generate an optical pulse with tunable pulse durations of 5 ~ 20 ns and the variable repetition rates up to 100 KHz. The peak power is about 25 W. The spectrum bandwidth of the broad-area laser increased from ~1 nm in the CW operation mode to more than 6 nm in the pulse operation mode with the pulse duration of ~ 7 ns. An external cavity with a diffractive grating (1200 l/m) is used to reduce the spectrum bandwidth and tune the wavelength of the laser. The external cavity length is limited in a few centimeters so that the feedback time is much less than the pulse duration. With such an external cavity, the pulsed broad-area laser was locked to a single frequency with the spectrum bandwidth less than 0.2 nm. We have not observed any noticeable change in either the peak pulse power or the pulse waveform due to the frequency locking. The wavelength of the pulsed laser was tunable within a range more than 5 nm. The output beam showed single spatial mode and most light output was successfully collimated into an optical fiber. The proposed method can be scaled up to achieve larger output powers either by locking an (stacked) array of broad-area lasers or through a cascading locking scheme.

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