Locking of Broad-Area Laser Arrays with External Cavity*

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Abstract

We present experimental results on the locking of a 19-broad-area semiconductor laser array by using a novel design of external cavity containing a lens array and a diffractive grating. All lasers are locked to the single wavelength. Significant improvement of the spatial profile has been observed. The wavelength of the center lobe is tunable over the range of 15 nm. The proposed technology can be applied to larger arrays including the stacked arrays.

A commercially available broad-area laser array (Coherent B1-20C) was used in the experiments. The entire array is driven with a common current source. Each broad-area laser in the array has an emission aperture of 125 μm×1 μm and is capable of emitting a maximum output power over 1W. The separation between two adjacent lasers in the array is 500 μm and the total array length is 1 cm. At the free-running state, the longitudinal modes of the 19 lasers spans over a wide range of 806 - 811 nm. In the array (slow-axis) direction, each laser emitter is separately collimated with a cylindrical lens array that was designed to match the laser array configuration. The light output from the array is fed back from a diffractive grating in a Littrow configuration through a telescope in the external cavity. The implementation of the lens array reduced the beam divergence in the slow-axis direction and accordingly enhanced the frequency locking. Experimental results show that all lasers are frequency-locked over the entire pumping current range from the threshold (~ 9 A) to 21 A where the output power of the laser array exceeds 20 W. The far-field pattern of the laser array shows significant improvement in terms of the energy ratio in the center lobe. The wavelength of the array output can be tuned over 15 nm with the side mode suppression ratio larger than 25 dB.

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