High-Power Laser Diode Beam Shaping for Incoherent Combining

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Abstract**—**This abstract presents the simulation and experimental approach and results of the beam shaping and incoherent beam combining of two kW-order laser sources using incoherent polarization combining at infrared wavelengths.

Keywords: Beam shaping; incoherent combining; high-power laser.

I. INTRODUCTION

The development of more compact laser sources for high-power applications have brought the possibility to replace in near future high-brightness laser sources for material cutting or processing.

Currently, the most widely used laser technologies for high-brightness industrial applications are disk, fiber, and CO2 lasers [1]. However, the availability of high-power commercial semiconductor laser diodes opens an opportunity to research on the development of bright laser sources based on beam combining at kW level [2], [3].

In this work, we are presenting the latest results from our team about the implementation of a kW incoherent laser diode stack beam combining. In section two of this abstract more details about the design are provided.

II. HIGH-POWER BEAM COMBINING

The incoherent beam combining implementation proposed in this work is depicted in Fig. 1. The laser sources used are laser diode stacks of ten laser diode bars emitting at 980 nm and having 110 W maximum optical power emission per bar. The laser diode bars are fast-axis collimated using micro lenses. For slow-axis collimation, commercial cylindrical lenses are used to obtain a rectangular emission shape.

Two 1-kW laser diode stacks are placed in orthogonal position one to the other. The beam combining is done thanks to the use of a polarization coated mirror. In front of one of the laser diode stacks (Laser Source 2), we placed a half wave plate to change the beam polarization, then, this beam is reflected by the polarization mirror.

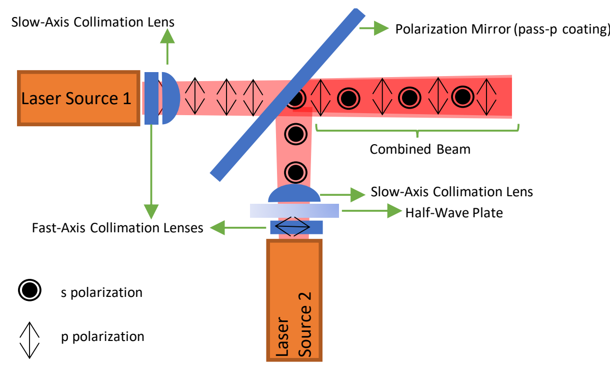

Figure 1. Schematic setup of the polarization-based beam combining (top view).

From the simulation results, it is feasible to implement the polarization-based incoherent beam combining with a power efficiency of 99%. However, in laboratory implementation, the efficiency can drop significantly considering aspects such as the smile effect of the diodes and thermal stress on the lenses. This is going to be explored during the experimental stage of this work and shared during the conference.

REFERENCES

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