

Laser Array

Mohammed Alahmed, Omar Alsagheer, Zyad Alazrnougi, Jillian Cantieni, Laura Christie, Thomas Dunham, Tariq Fievre, Daniel Leles, Samuel Paulson
 Faculty Advisor(s): Dr. Ed L. Caraway Dept. of Electrical and Computer Engineering, Florida Institute of Technology

ENGINEERING & SCIENCE STUDENT DESIGN SHOWCASE

FLORIDA TECH

Abstract

The objective of this project is to design a blue light laser using diodes, GRIN lenses, and etched multimode optical fibers to focus enough power into a combined focal point to machine copper.

Introduction:

Laser Diode

- Laser Diode is a semiconductor device that emits coherent light using PN junction.
- There are three conditions to consider a light-emitting diode as a laser: proper energy emission, population inversion, and saturation of laser beam intensity.
 - Energy emission is when electrons emit photons by dropping from higher to lower energy levels, and there are two types of PN junctions' emission: stimulated and spontaneous.
 - Population inversion when there are more electrons in the upper energy level than in the lower.
 - Laser beam intensity saturation occurs when the gain of a beam in a medium has increased to a point where the energy stored in upper energy levels can no longer satisfy the gain requirements.

Blue laser welding

- Laser welding is known as the process that makes the metals and the thermoplastics join.
- The reason for using high-power lasers is to melt the copper. The type of the laser is important to control the absorption of energy and depending on the wavelength of light.
- Infrared light which has 900-1100 nm is a common type of laser welding. Blue light is typically 450-495nm but has greater energy per photon.
- Infrared light used usually with high conductive materials and low energy absorptivity.

System Operation:

- Use voltage supply to power the laser diode
- 5W Laser diode with GRIN lens to align with fiber optics.
- GRIN lens placed in front of the laser diode to help collimate the output.
- The laser diode is embedded into a copper-machined mount for heat dissipation.
- The block is mounted on a Peltier cooler to adjust the laser diode temperature and prevent it from overheating.
- Use TC-24-10 PI controller connected to the power supply and the Peltier cooler to control the temperature.
- The PI controller sends a PWM signal to the cooler where the width is adjusted according to the required temperature.
- Raspberry PI captures a picture of the laser and processes the image to measure beam radius at the detector.

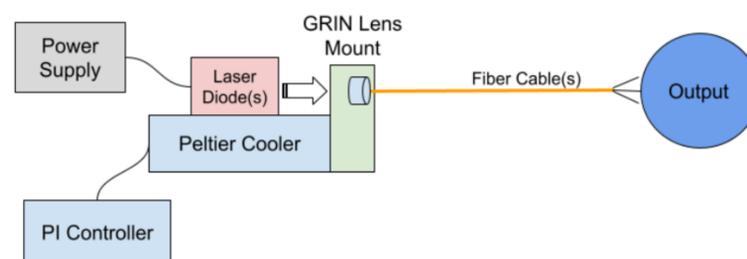


Figure 1: System Design Concept

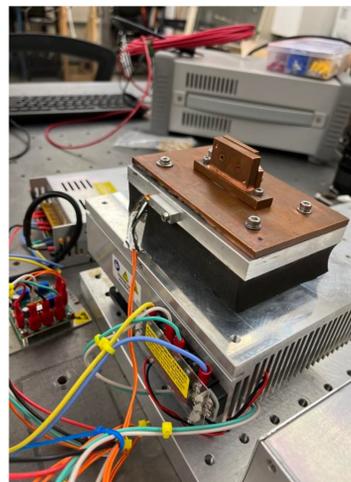


Figure 2: System Overview

Results:

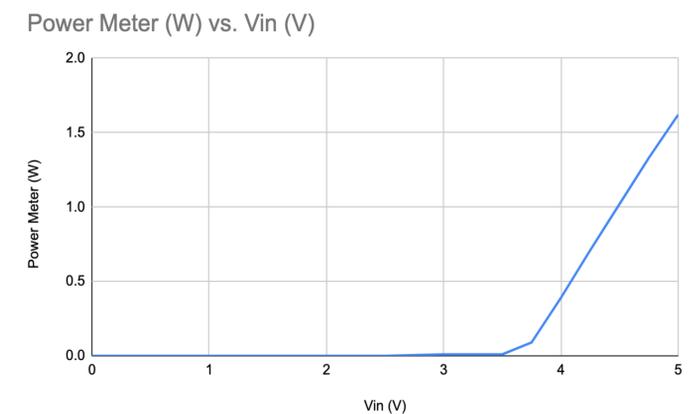


Figure 3: Test Laser VI Characteristics

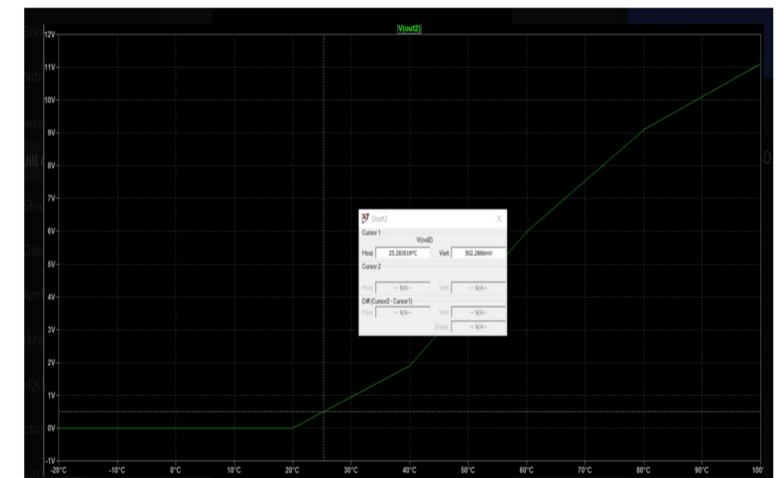


Figure 4: PI Controller Output voltage vs Temperature simulation

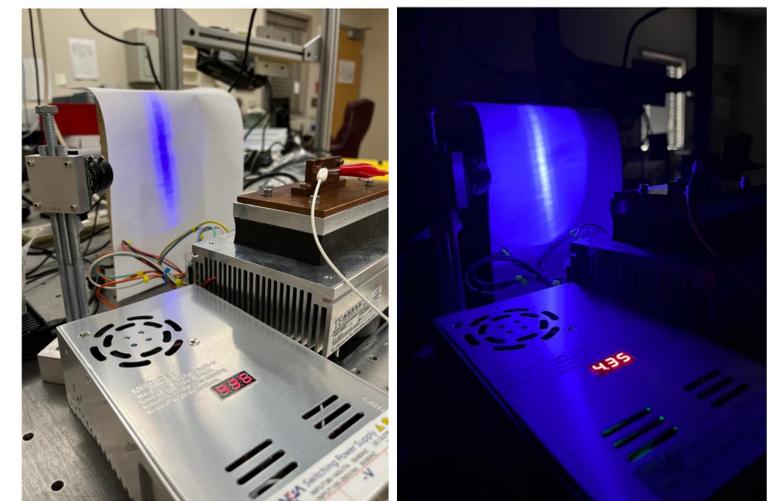


Figure 5: Laser Diode Output