Lab work: study of a laser diode

Laser diodes are widely used optoelectronic components. The aim of this lab work is to study the characteristics of this kind of light source. The used laser diode emits at about 630 nm (and is thus made of AlGaInP) and can deliver up to 10mW of light.

In order to reduce the danger to your eyes, we limited the diode output to approximately 5 mW. IF YOU ARE CARFUL, you may thus use it without protection glasses. When manipulating please

- Remove any jewelry, watches etc.
- Take care to block the light every time you want to use a tool on the setup. This is the most common laser accident: reflecting the laser with a tool in the eyes of a colleague!
- Never stare into the beam

Laser diodes are very sensitive to electrostatic damage. It is thus of major importance to apply the following rules:

- Keep the cables connected at all times.
- For both boxes, temperature regulation and power supply, do not switch of the mains power of the electronics during the whole session. Only use the button at the upper right edge of each of the boxes.
- Pull down the diode current to the minimum value before switching the diode power supply (button on the upper-right).

The temperature regulation includes a Peltier cooling element, and a heater. The regulation is of PID-type. Please do not alter the PID parameters. Avoid values below 15°C, condensation may occur.

At constant current, the output power of the diode increases when the temperature decreases. Please take care not to saturate the power meter. Best simply use the power meter at the 10 mW range for all measurements.

Experiments:

The aim is to make the technical specification sheet of the diode (except maximum output power). Explanations on the used measurement protocols, the used theoretical aspects and the uncertainties of the results are expected to show up in the report. Compare your results with the official spec sheet.

More precisely, measure at least:

- The divergence angles
- Polarization type and ratio. Indicate the direction of the polarization with respect to the PN-junction.
- Threshold current I_T at 15°C.
- The variation $\Delta I_T / \Delta T$ (by measuring using at least 5 temperatures)
- The slope efficiency $\Delta P/\Delta I$ in lasing regime for 20°C and.
- The spectral variations: $\Delta\lambda/\Delta T$, $\Delta\nu/\Delta T$ (and $\Delta\lambda/\Delta I$, $\Delta\nu/\Delta I$ by using the Fabry-Perot etalon).
- Give a schematic representation of the emission spectra in fluorescence and lasing regime. Analyze their FWHM, conclude on the coherence of the irradiation.

Where I is the pump current, I_T the threshold current for lasing to occur, T the temperature, P the (optical) output power and λ the vacuum wavelength.

Material list

A laser diode with its power supply (stabilized current source) and the temperature regulation.
A power meter
A polarizer
A spectrometer with a resolution of 3 nm.
A wrench to adjust/remove the collimation optics.