



Application Note for mGreen Module

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1. Introduction

mGreen Module is a single component for green light generation. By simply pumping the mGreen with an 808nm LD, the user can easily achieve 250-1000 mW of green light output.

2. Module Description

The mGreen Module consists 4 components, as shown schematically in **Fig.1**, i.e. a silicon subcarrier; a Nd:YVO₄ crystal, a MgO:PPLN crystal, and a brass cover. The Nd:YVO₄ and MgO:PPLN crystals are precisely aligned and mounted on a Si substrate so that facets of the two crystals are in parallel to each other. The c-axis of the Nd:YVO₄ and MgO:PPLN are both aligned in the vertical direction. The input facet of the Nd:YVO₄ crystal was coated for high transmission at 808 nm pump wavelength, and high reflection at both 1064 nm and 532 nm wavelength. The output surface of the MgO:PPLN crystal has a high reflection coating for 1064 nm and high transmission coating for 532 nm light. The mGreen Module has a small size of only 7(L) × 4.5(W) × 2(H) mm³ (i.e. 0.063 c.c.).

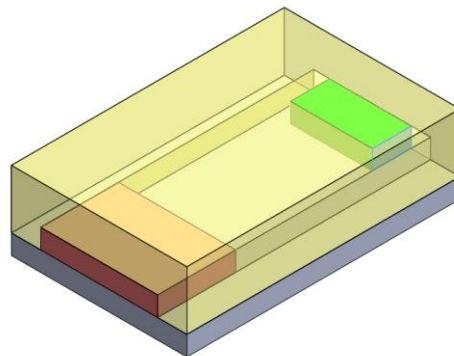


Fig. 1. 3D structure of the mGreen Module.

3. Construction of a green laser

To build a green laser based on the mGreen Module, it only requires an 808nm pump laser diode in C-mount or F-mount packaging and some accessories (such as TEC). **Fig.2** shows a schematic structure of a green laser built using an mGreen



Module and a C-mount 808nm LD. It is worth noting that:

1. To achieve the best performance of the mGreen Module, the 808 nm LD needs to be rotated by 90° , since most 808nm LDs emit TE polarized light, as shown in **Fig.2**;
2. The mGreen Module needs to be set in a way that the silicon subcarrier is contacted with a heat sink or the TEC;
3. The distance between the 808 nm LD and mGreen Module can be set at about 1 mm;
4. No focusing lens or coupling mirror are needed;
5. 808 nm LD with a fast axis collimation (FAC) should be used. Usually the pump LD with the FAC has a beam divergence of around 7 degree in both directions, which can result a square shaped beam. Of course, if the user wants to apply more complicated lenses for pump beam reshaping and focusing, the performances of the mGreen Module can be further enhanced in terms of green light power.
6. The brass cover is a protection for mGreen Module's key components. It cannot be pressed firmly.

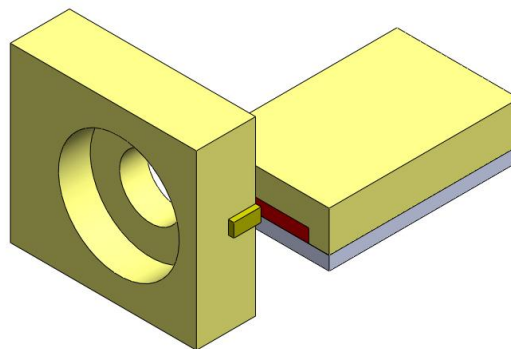


Fig. 2. A schematic structure of a green laser using an 808nm LD and an mGreen Module.

4. Alignment

Although the mGreen Module itself is a single alignment-free module, i.e. there is no need to adjust the Nd:YVO_4 and MgO:PPLN within, the user still needs to adjust the relative position between 808nm LD and the mGreen on the platform. This is the only alignment step that the user has to encounter in making an efficient green laser. **Fig. 3** shows the geometric dimensions of the mGreen Module. The vertical dimension of the crystal is 0.5 mm or 500 μm . Therefore, it is needed to design and fabricate the platform with a tolerance of several tens of micrometers so that the pump LD's



emitting center is positioned in the center of the crystal. In contrast, transverse positioning is not critical since the effective width of the crystal is about 1.5 mm.

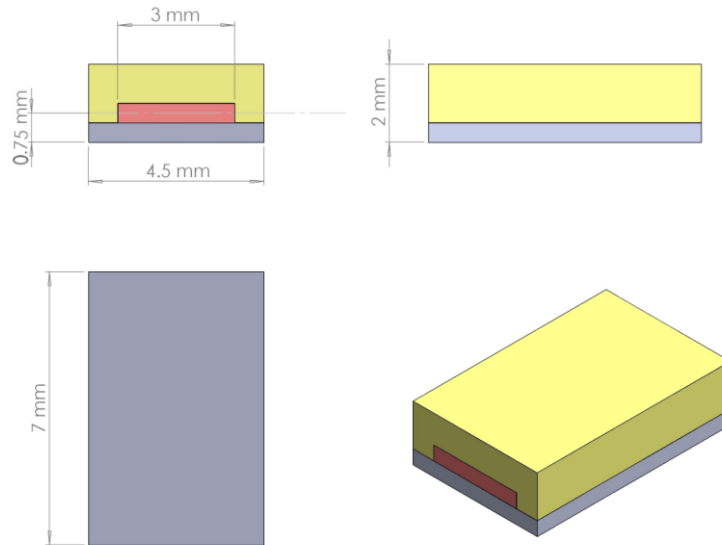
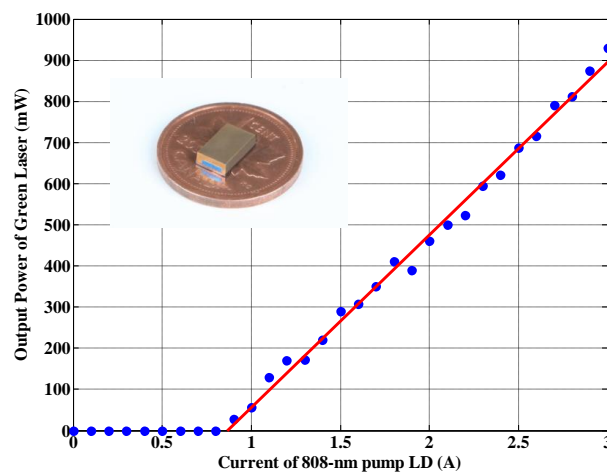


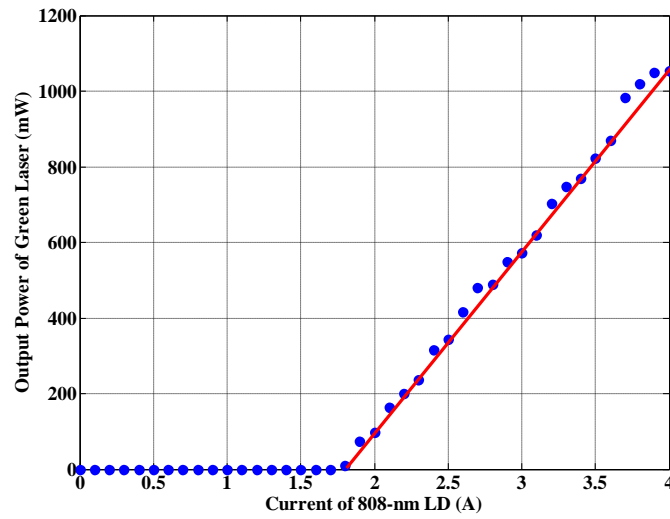
Fig. 3. Geometric dimension of the mGreen Module

5. Typical performance

When assembling the 808 nm pump LD and mGreen Module on a platform to form a green laser, more than 900 mW and 1000 mW green light can be obtained by using a 3 W and 4 W 808 nm pump LD respectively. **Fig.4** (a) and (b) show typical experimental results of the mGreen Module with 3 W and 4 W 808nm LD.



(a)



(b)

Fig. 4. Pump current vs. green power of a typical mGreen Module.

Inserted is a photo of mGreen Module.

Appendix: Specifications for the mGreen Module

Material	Nd:YVO ₄ /MgO:PPLN
Pumping Wavelength (nm)	808 nm+/-2 nm
Operating Temperature	20-30°C
Coating of Facets	Input: HT@808nm, HR@1064nm & 532nm; Output: HR@1064nm, AR@532nm.
Optical to Optical Efficiency	≥ 20%
Dimension	7.0 mm(L)x4.5 mm(W)x2.0 mm(T): 0.063 c.c.
Others	Packed with a substrate and a metal cover

References:

1. C. Q. Xu, et al, "MgO:PPLN frequency doubling optical chips for green light generation: from lab research to mass production", Photonics West 2012, paper 8280-4.
2. Y. Lu, et al., "MgO:PPLN Based Green Lasers for Portable Laser Projectors", Photonics West 2012, paper 8280-3.