Compact green light sources for laser projection display

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Abstract

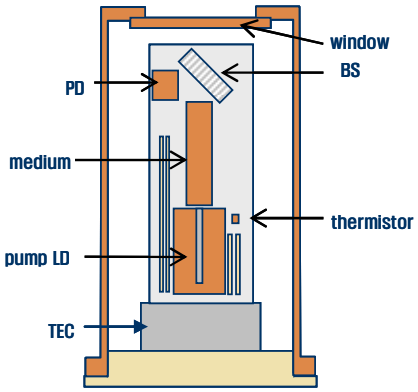
A compact diode-pumped microchip(DPM) green light source which consist of pump LD, Nd:YVO_4, KTP and a built-in thermoelectric element has been fabricated for laser projection display . The volume of the source is as small as 0.7 cm^3 and we obtained the output power of 25mW with the average electric power consumption in pump LD of 304mW which correspond to the electrical-to-optical efficiency of 7.8%. Another approach using quasi phase matching(QPM) technique has been attempted. We obtained the output power of 90mW of green beam with 350mW pumping of a Nd:YVO_4 laser with 20-kHz rep. rate and 10-ns pulse duration. Detailed characteristics and issues of the DPM and QPM green light sources will be addressed.

1. Introduction

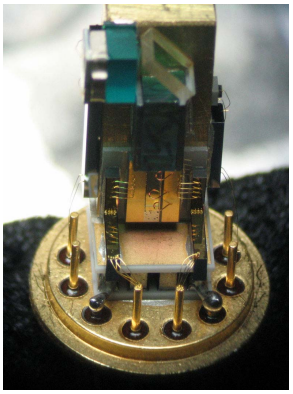
These days it is very common that the mobile phones contain one or some additional functions such as DMB, camera, games, music video, and MP3 player. Mobile devices can receive, send and store pictures and videos, but viewing them on a small screen isn't satisfactory. To solve the problem, some major IT and display companies were great interested in putting the projectors in phones. And this mobile-phone projector was chosen as one of six of the year 2006's most compelling information technology stories and now it is almost ready to launch[1]. One of the main problems in making RGB laser sources for laser projection display is the down-sizing the green light source. In this paper, we report the fabrication, characteristics, and issues of DPM and QPM green light sources.

2. Compact DPM green light sources

Fig. 1 shows the developed green light sources. A thermoelectric element was epoxy-bonded onto a round stem base that had eight leads. We used a small chip-on-submount type IR laser diode (Lumics LU0808S250) as pump source. The wavelength and the maximum optical power, and operating current is 808 nm, 250mW, and 310mA, respectively. A laser medium, diffusion-bonded Nd:YVO_4/KTP composite crystal(Fujian Castech) was placed 100 μm away from the pump LD.



(a)



(b)

Fig. 1. Structure of the DPM green source: (a) schematic diagram (b) real image of the internal structure.

The diameter of the cap and stem base was 8 and 9 mm and the height of the module was 13mm except leads, resulting in total volume of less than 0.7 cm^3. Fig. 2 shows the output average power and the electric power consumption of the TEC according to the temperature.[2]

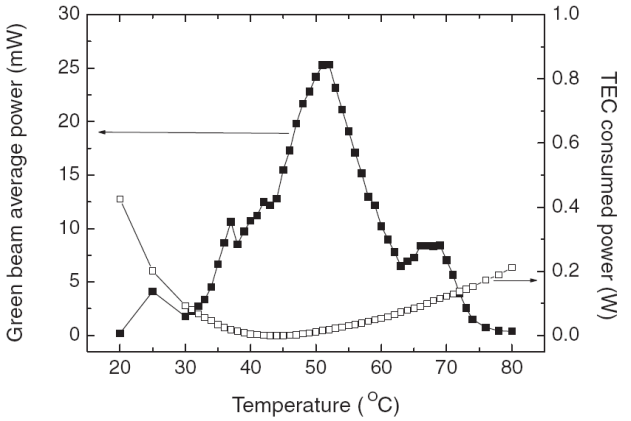
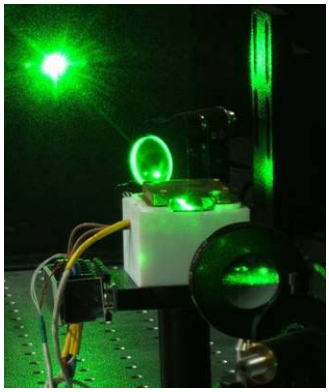


Fig. 2. Temperature dependence of output green beam power and TEC consumed electric power.

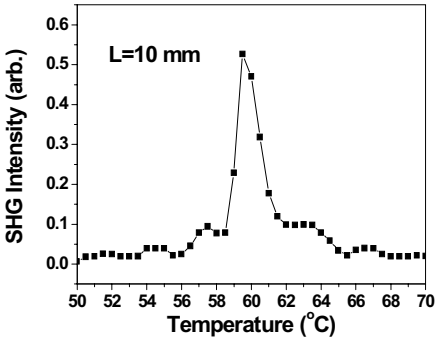
At 51℃, the maximum output was generated and the average electrical power consumed in the TEC was 15mW. Power was so stable with the fluctuation of 0.15% and the spatial beam profile was almost perfect Gaussian.

3. QPM green light sources

We have fabricated the periodically-poled lithium niobate(PPLN) and generated green light by second harmonic generation(SHG) of pump laser. We have used a 10-mm long, 0.5-mm thick PPLN with the period of 6.9 μm. Fig. 3 shows the picture of the experiment and the SHG intensity according to the temperature of PPLN. More detailed experimental results and the issues will be discussed in the presentation.



(a)



(b)

Fig. 3. (a) Experimental setup for SHG with PPLN (b) the SHG intensity according to the temperature of PPLN

4. Acknowledgement

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5. References

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