330nm UV Generation from combined cavity's DVD laser diode and nonlinear crystal

(複合共振器構成の DVD-LD と非線形光学結晶による 330nm 紫外光発生)

Vesarach Pratkasem
ID.1075066

A dissertation submitted to
The Kochi University of Technology
in partial fulfillment of the requirements for
The master degree of engineering

Supervisor
Associate Professor Koji Nonaka

Course of Electronic and Photonic Engineering System
The Kochi University of Technology
Kochi, Japan

February 2005

Abstract

The commercial coherent UV light sources such as excimer laser and solid-state laser are complex to fabricate and have large-scale structure; moreover, they require high manufacturing and maintenance costs. Because of these disadvantages, the alternative coherent UV light sources that can solve these problems have been desired. In this thesis, the indirect method to generate UV light from laser diode is used, that is the using of Second-harmonic generation (SHG) process from β-BaB_2O_4 (BBO) crystal. The most cost effective compact size coherent light source in the market is the DVD laser diode so it is used as the fundamental input light source for the SHG system of this thesis. The SHG process is the technique that can convert the light a one wavelength to the light at another wavelength. The wavelength of the generated light is half of the input light. Since the wavelength of the DVD laser diode is around 660 nm, the generated light has the wavelength around 330 nm, which is in the UV-A region. But the spectral acceptance bandwidth of the BBO crystal is narrow, and since the spectrum of the normal DVD laser diode is fluctuate and has wide bandwidth, the generated UV from SHG process has low and fluctuate power. Therefore, the optical feedback from diffraction grating is used in order to stabilize and narrow the spectrum of the DVD laser diode. When the diffraction grating is used, the amount of generated UV power of the SHG system become stable and is increased to 2.4 times compare to the system without the diffraction grating. The enhancement in the performance of the SHG system is due to the stability of the spectrum of the DVD laser diode from the using of optical feedback. Another interesting feature of the using of diffraction grating is that, the tuning of UV wavelength is possible. The tuning ability comes from the wavelength selective nature of the diffraction grating. The wavelength of the optical feedback from the grating depends on the angle of the grating's normal to the laser diode's beam direction. Therefore, when the diffraction grating's angle is tuned, the feedback wavelength is changed. There are two factors that limited the tuning range of UV wavelength; the deviation of the optical feedback direction and the shifting in the gain spectrum of DVD laser diode. From the experiment, UV wavelength tuning from 329.5 nm to 332 nm, which is according to 2.5 nm tuning range is achieved.