비선형 단결정 LiB_3O_5와 $CsLiB_6O_{10}$을 이용한 Nd:YAG 레이저의 4차 및 5차 조화파 발생

Fourth and Fifth Harmonic Generations of an Nd:YAG Laser using Nonlinear Optical LiB_3O_5 and $CsLiB_6O_{10}$ Crystals

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All solid-state UV lasers provide efficient, clean and semipermanent light sources for various applications, such as eye surgery, microchip lithography. $CsLiB_6O_{10}$ (CLBO) is one of the most suitable crystals for UV generation because of its small walk-off, large effective nonlinear susceptibility in UV region and high damage threshold. We produced fourth (266 nm) and fifth (213 nm) harmonic generation of an Nd:YAG laser (1064 nm) with LiB_3O_5 as a second harmonic generation medium and CLBO as a fourth harmonic and fifth harmonic mediums. A second harmonic energy of 4.7 mJ was obtained from the fundamental input energy of 30 mJ (Fig. 1(b)) and a fourth harmonic energy of 1.12 mJ was produced from the second harmonic input of 4.7 mJ (Fig. 2(a)), which corresponds to a conversion efficiency of 25.8 %. A fifth harmonic energy of 1.03 mJ was obtained by sum-frequency generation of the fundamental and fourth harmonic beams, corresponding to a conversion efficiency of 3.43 % relative to the fundamental input energy. The fifth harmonic energy was measured as a function of pump intensity and incidence angle for two different crystal lengths, L. The fifth harmonic, conversion efficiency for L = 11.9 mm is much larger than that for L = 6.9 mm (Fig. 2(b)).

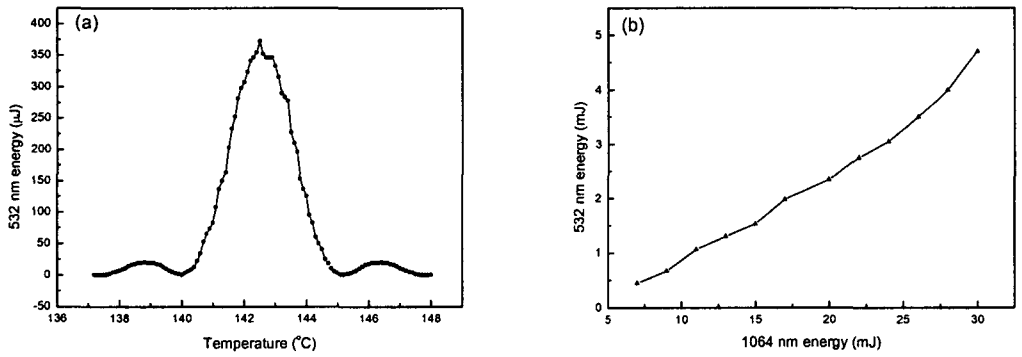

Fig 1. (a) Temperature tuning curve for type I second harmonic generation in LiB_3O_5. (b) Output energy of the second harmonic waves as a function of fundamental wave energy.

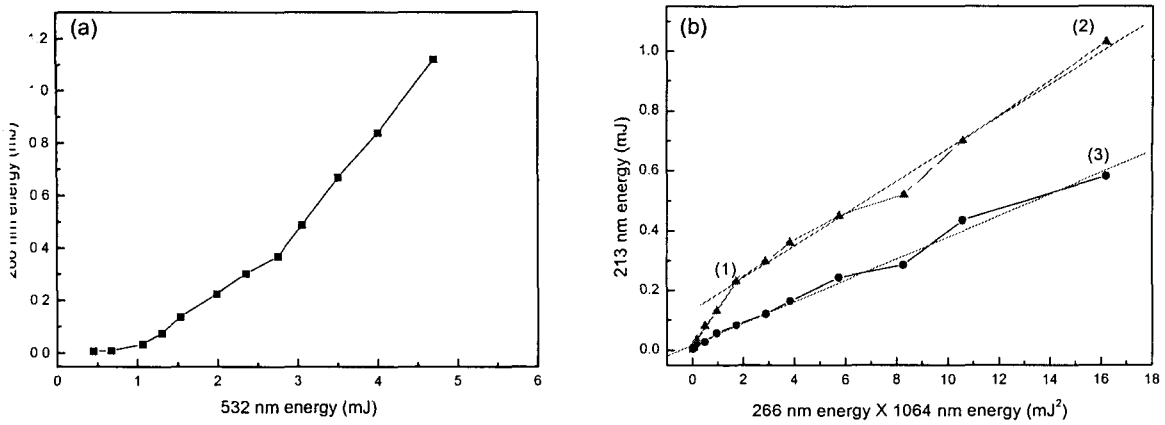

Fig 2. (a) Output energy of the fourth harmonic waves (266 nm) as a function of second harmonic wave (532 nm) energy. (b) Output energy of fifth harmonic waves (213 nm) as a function of the product of the energies of fundamental and fourth harmonic waves for two different CLBO crystal lengths (● ; L= 6.8 mm, ▲ ; L = 11.9 mm).

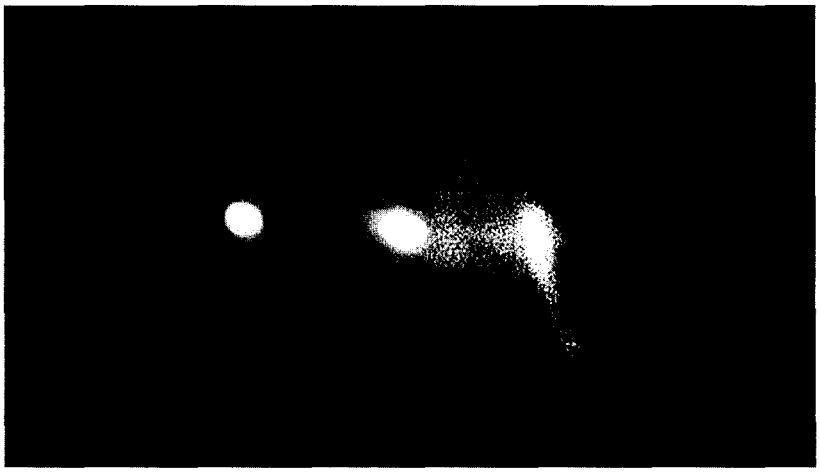

Fig 3. Photograph of fifth (213 nm), fourth (266 nm) and second (532 nm) harmonic beams separated by a prism (from left to right). Most of the second harmonic beams were blocked.