Visible and ultraviolet light sources based nonlinear interaction of lasers

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Visible and UV light sources based on nonlinear interaction of lasers

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1. Abstract

Different light sources can be used for optically stimulated luminescence measurements. Usually, a halogen lamp in combination with filters or light-emitting diodes (LED's) are used to provide the desired stimulation wavelength. However, lasers can provide a more precise, well-defined beam with a narrow spectrum, high intensities and fast-pulsing characteristics. Apart from potential significant reductions in measurement requirements as compared to LED's, these characteristics help in accurate examination of different trap parameters. In this paper, we present a general approach for effectively synthesizing any wavelength in the visible and ultraviolet light based on sum frequency generation between two lasers.

2. Introduction

The development of efficient, compact, and robust laser sources in the visible and UV spectral range is the subject of extensive research, for applications in areas as diverse as optical spectroscopy, projection displays, and biological diagnostics. The generation of visible light from optically-pumped solid-state and semiconductor lasers is usually achieved through second harmonic generation (SHG), as the transition lines of most conventional doped dielectric laser crystals and the bandgaps of the most common III-V semiconductor alloys are in the near infrared region (NIR).

Using this general approach based on sum frequency generation (SFG) between two laser sources, effective generation of light can be achieved at hard to get wavelengths. However, lasers can provide a much more well-defined beam, very narrow spectrum, high intensities and fast-pulsing characteristics. Apart from potential significant reductions in measurement requirements as compared to LED's, these characteristics help in accurate examination of different trap parameters. In this paper, we present a general approach for effectively synthesizing any wavelength in the visible and ultraviolet light based on sum frequency generation between two lasers.

3. Sum Frequency Generation

The nonlinear crystal is a periodically poled KTP quasi phase matching the sum frequency interaction. Appropriate choice of single pass source is effectively converted to the desired wavelength.

4. Continuous Wave 488nm generation (Blue)

**Single pass source**: 765nm Tapered diode laser
**Resonant laser**: 1342nm Nd:YVO4

Tapered Diode Laser

488nm was picked as a proof of principle and to demonstrate a small and compact alternative to the Argon ion laser.

More than 300mW 488nm light was generated with a single pass conversion efficiency of 52%.

Previous work on this generation of 488nm has been demonstrated.

This offers a viable and better alternative to the blue LED's in OSL measurements.

5. Pulsed 593nm generation (Yellow)

**Single pass source**: 1064nm Q-Switch Nd:YAG laser
**Resonant laser**: 1342nm Nd:YVO4

Pulsed operation was demonstrated by generating 120W of 593nm peak power with a FN of 75.

Pulsed generation of 340nm UV light through a cascaded process generating sub milliwatt average power was demonstrated.

Synthesizing of any wavelength in the visible and UV spectral region, with high efficiency for both pulsed and continuous wave can be realized using this approach.

These visible light sources generate sufficient power and can have flexible pulsing characteristics (fs to ms scale) to replace LED's for dedicated OSL applications such as excitation spectroscopy and time resolved OSL measurement.

6. Pulsed 340nm generation (UV)

**Single pass source**: 1064nm Q-Switch Nd:YAG laser
**Resonant laser**: 946nm Nd:YAG

Pulsed operation was demonstrated by generating 120W of 593nm peak power with a FN of 75.

Pulsed generation of 340nm UV light through a cascaded process generating sub milliwatt average power was demonstrated.

Synthesizing of any wavelength in the visible and UV spectral region, with high efficiency for both pulsed and continuous wave can be realized using this approach.

These visible light sources generate sufficient power and can have flexible pulsing characteristics (fs to ms scale) to replace LED's for dedicated OSL applications such as excitation spectroscopy and time resolved OSL measurement.

7. Conclusions

- Using the proposed general approach, more than 300mW of CW of 488nm light was generated.
- Pulsed operation was demonstrated by generating 120W of 593nm peak power with a FN of 75.
- Pulsed generation of 340nm UV light through a cascaded process generating sub milliwatt average power was demonstrated.
- Synthesizing of any wavelength in the visible and UV spectral region, with high efficiency for both pulsed and continuous wave can be realized using this approach.
- These visible light sources generate sufficient power and can have flexible pulsing characteristics (fs to ms scale) to replace LED's for dedicated OSL applications such as excitation spectroscopy and time resolved OSL measurement.

8. References