High-Efficiency 532-nm Generation with PPSLT

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Motivations

- To efficiently generate green light using a periodically polled stoichiometric lithium tantalate (PPSLT) crystal.
- To compare the performances of MgO-doped and undoped PPSLT crystals.
Fundamental beam parameters

- Average power = 22 W
- Repetition rate = 200 kHz
- Pulsewidth < 7 ns
- Spectral width 0.08 nm
- $M^2 = 1.19$ (horizontal), 1.14 (vertical)
- Wavelength = 1064 nm
Oven design

- Aluminum base
- Peek insulating block
- Copper crystal mount
- Macor cover
- Teflon cover
- Peek insulating block
- Aluminum base
- IR
- Green
Temperature tuning curve, MgO-Doped

- Crystal size:
  - Height = 0.5mm
  - Width = 2 mm
  - Length = 20 mm

- FWHM of tuning curve = 1.6 °C
SHG power and efficiency

532-nm power vs. 1064-nm power for a MgO-doped PPSLT crystal.

The SHG efficiency as a function of intensity for a MgO-doped PPSLT crystal.
SHG model applied to NCPM LBO

Theory for 2.4-cm crystal

Theory for 1.8-cm crystal

Data points

Note: Intensity is peak in space and time
Average spatial intensity is half the value shown
Calculation of efficiency in PPSLT
Green beam profiles at different IR powers

MgO-doped crystal at 35.5 °C
Temperature tuning curve

FWHM = 1.6 °C

Undoped PPSLT crystal at 82 °C
MgO-Doped vs. Undoped Crystal

Green power as a function of 1064-nm power for MgO-doped and undoped PPSLT crystals.

SHG efficiency as a function of 1064-nm intensity with and without MgO doped PPSLT.

• Undoped crystal:
  Height = 0.5 mm
  Width = 11 mm
  Length = 20 mm
  Width of grating = 1 mm
  Beam size = 666 x 254 μm

• MgO doped crystal:
  Height = 0.5 mm
  Width = 2 mm
  Length = 20 mm
  Beam size = 1296 x 244 μm
Green beam profile at different IR power

Undoped PPSLT crystal at 82 °C
Green beam profile at different IR power

Undoped PPSLT crystal at 170 °C
Conclusions

- MgO doped PPSLT crystal shows 6% IR power absorption compared to 2% absorption in the undoped crystal.

- Beam distortion due to photo refractive damage occurs at
  - ~3 MW/cm² for MgO doped crystal at 35.5 °C
  - ~1 MW/cm² for undoped crystal at 82 °C
  - ~2.7 MW/cm² for undoped crystal at 170 °C

- Doping with MgO increases the photo refractive damage threshold

- Increasing the temperature in the undoped PPSLT also increases the photo refractive damage threshold

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