High-Power, Ultra-Broadband THz Generation in Organic Crystal MNA

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Motivation

THz source based on optical rectification in a new generation of nonlinear organic crystals:

- High power (>1 mW), high efficiency (percent level) and ultra broad bandwidth (>10 THz)
- Discovering, synthesizing and characterization of new crystals through structural data mining [1]
- Exceeding the performance of industry standards in terms of crystal size and quality

MNA (Amino-5-Nitrotoluene): a good candidate to be investigate with high power, high repetition rate, Yb-based pump laser:

- High molecular hyperpolarizability
- Relatively large molecular number density
- High nonlinear coefficient of 250 pm/V [2]

THz-TDS setup

Driving laser: TruMicro 2000, TRUMPF

\[ \lambda: 1030 \text{ nm} \quad P_{\text{avg}}: 18 \text{ W} \]

\[ f_{\text{rep}}: 400 \text{ kHz} \quad \tau_p: 35 \text{ fs (after MPC)} \]

THz generation

MNA crystal thickness: 1 mm
Beam diameter \((1/e^2)\) on the crystal: 2.3 mm

Detection crystal

MNA with thickness of 0.65 mm or gallium phosphide (GaP) with thickness of 0.1 mm

Results & Discussion

THz power measured by a calibrated power meter

Maximum THz power at pump power of 5.3 W: 5.2 mW
Maximum efficiency at pump power of 5.3 W: 0.08%

Detection GaP \(\rightarrow\) Bandwidth of 7 THz
Detection MNA \(\rightarrow\) Bandwidth of 12 THz

Electro optic sampling (EOS)

Conclusion & Outlook

- A high average power (5.2 mW), ultrabroadband (>12 THz), and high dynamic range THz-TDS based on MNA
- A unique tool for a variety of spectroscopy experiments and nonlinear THz spectroscopy
- Power scaling by optimizing the pump spot, reducing the repetition rate of the laser and operating in purged conditions