

Nonlinear Mid-Infrared Generation using the Chromacity Spark 1040

The high average power and high peak power of the Chromacity Spark 1040 can be used to generate mid-infrared light from 1.4 – 4 μm by pumping optical parametric oscillators. These OPOs can be used as a source for broadband infrared spectroscopy, Fourier-transform spectroscopy and stand-off detection.

Optical parametric oscillators

The nonlinear response of certain crystals, such as lithium niobate, allows the generation of shorter wavelengths via second-harmonic generation and sum-frequency mixing, or longer wavelengths by parametric down-conversion. An optical parametric oscillator (OPO) makes parametric down-conversion highly efficient by placing the nonlinear crystal inside a high-reflectivity cavity:

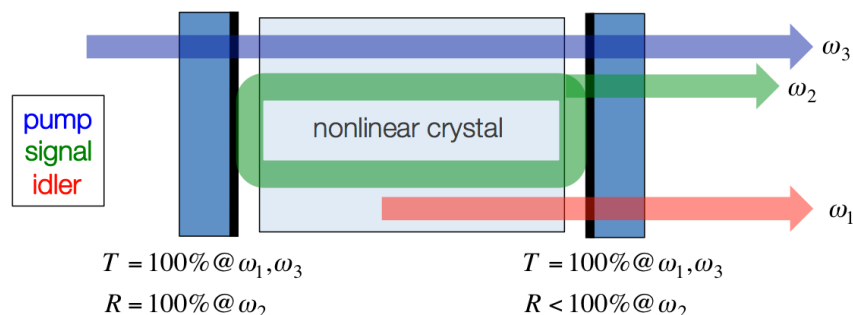


Fig. 1. Schematic representation of an optical parametric oscillator.

Converting a regular sequence of femtosecond pulses using an OPO requires the use of a cavity which is exactly length matched ("synchronous pumping") to that of the Spark 1040 laser, for example a simple 4-mirror design (Fig. 2). Tuning in a synchronously pumped OPO is available by either changing the crystal angle / grating period or adjusting the cavity length.

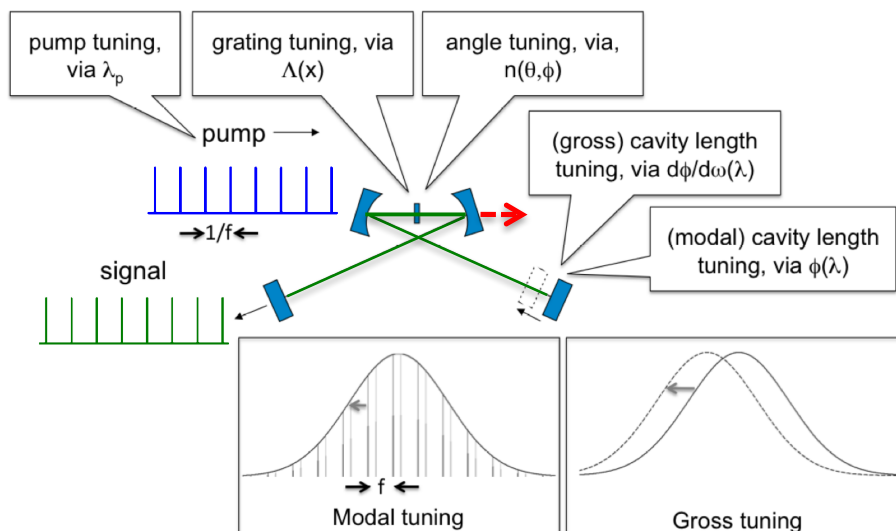


Fig. 2. Layout and tuning implementation in a synchronously pumped optical parametric oscillator

Optical parametric oscillator pumping using the Spark 1040 femtosecond laser

The Spark 1040 can easily generate a broad range of wavelengths using a commercial off-the-shelf MgO:PPLN crystal¹. Fig 3. shows spectra of the mid-infrared idler and near-infrared signal that is typically generated. Tunability throughout the 1.4-2.0 μm and 2.1-4.2 μm regions is obtainable using a suitable MgO:PPLN crystal and mirror set. Powers of around 10 mW in the idler and 50 mW in the signal are available with picosecond pulsed output, higher powers are provided in a quasi-CW regime.

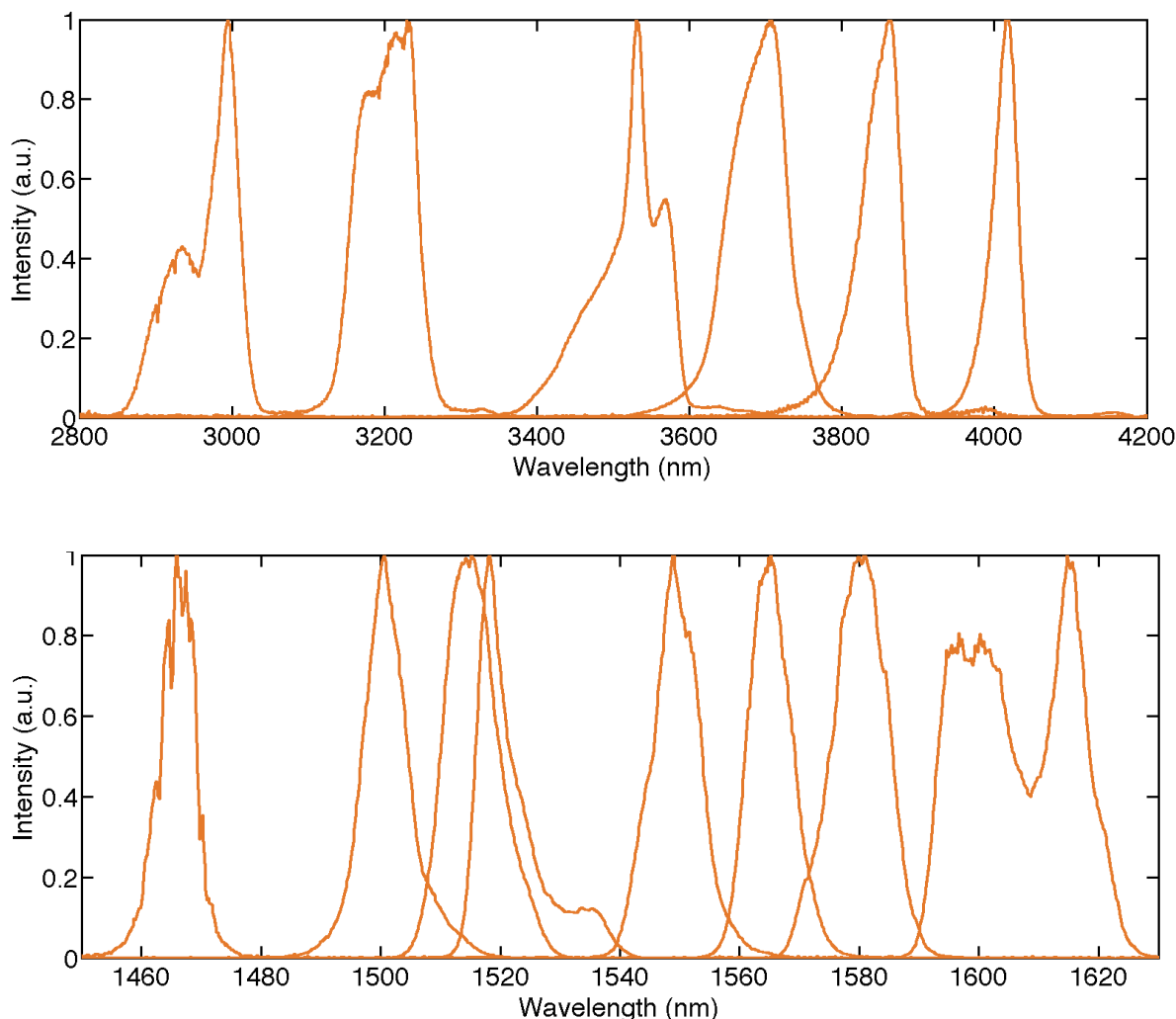


Fig. 3. Idler (top) and signal (bottom) spectra obtained from a Spark OPO pumped by a Spark 1040.

Summary

Using optical parametric oscillation, output from the Spark 1040 can be converted into the near- and mid-infrared spectral region. Its excellent stability allows synchronously-pumped OPOs to operate with high stability across a wide wavelength range.

Please contact us to discuss your OPO application needs.

References

¹ MOP01-0.5-1 crystal from Covesion (www.covesion.com)