Nanosecond pulsed middle infrared coherent sources based on frequency down-conversion in non-oxide nonlinear optical crystals

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Pulsed radiation of high power and energy in the mid-wavelength (MWIR) and long-wavelength (LWIR) infrared (IR) spectral ranges is important for remote sensing, spectroscopy, medicine, and defense applications. Sources covering the 3-15 µm wavelength range are mainly based on optical parametric oscillators (OPOs) with nonlinear optical crystals. The availability of other solid-state sources is restricted to quantum cascade lasers and transition metal-doped chalcogenide lasers, which are limited in wavelength coverage, average power and temporal regimes. Zinc-germanium-phosphide (ZGP) is the most widely used material in OPO experiments due to its superior properties as a nonlinear material suitable for IR conversion when pumped near 2 µm. Besides mature ZGP crystals, new promising nonlinear materials based on non-oxide compounds are emerging, cadmium silicon phosphide (CdSiP2 or CSP) or barium chalcogenides are potential alternative crystals with similar capabilities, which potentially suppress some limitations of ZGP related to residual absorption at the pump laser wavelength and enable pumping at shorter wavelengths (1.5 or even 1 µm). Selenium compounds show also much longer mid-IR cut-off wavelengths compared to ZGP, outperforming it above 10 µm.

The presentation will provide an overview of various aspects of power scaling, beam quality improvement and polarization control of ns-pulsed ZGP OPOs and comparison with other nonlinear optical crystals.