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Narrowband picosecond laser light sources for wide infrared spectral range based on nonlinear light conversion

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Widely tunable, narrowband mid-infrared coherent sources realised using optical parametric oscillators play an essential role in spectroscopic research. A part of the mid-infrared spectral region represents the “fingerprint range” of solid-state materials; therefore, a narrow bandwidth is a particularly important feature. Typically, a bandwidth of 2–5 cm^{-1} is required to satisfy the necessary resolution for spectroscopy of solids. Only a limited number of laser sources can generate such a narrowband radiation.

The biggest challenge is meeting customer’s needs by providing a set of high-performance parameters from a single device simultaneously: a broad spectral range, high spectral resolution, fast wavelength tuning, a high repetition rate, and a stable beam direction. Ideally, all these features must be maintained throughout the entire spectral range of the laser source. The range of 540–750 cm^{-1} presents a specific challenge in achieving a reasonable output power and other parameters required for practical infrared spectroscopy. These capabilities are relevant for various spectroscopic applications, especially for scanning near-field optical microscopy (SNOM), for example, near-field fingerprint spectroscopy of 2D electron systems [1], near-field imaging of the hybrid plasmon-phonon polaritons [2].

This presentation will describe the architecture and applications of Ekspla broadly tunable commercial ns and ps laser sources operating from 1.4 μm to 18 μm based on Mid-IR nonlinear optical crystals. Ekspla developed Mid-IR laser series guarantee a spectral bandwidth of less than 4 cm^{-1} which is close to the Fourier-transform limit for ~8 ps pulse at 1064 nm. Advantages and limitations of these laser sources in different narrowband OPO setups will be presented.

These lasers can also have a second optically synchronised output channel to support scientific applications which need laser pulses in the different spectral ranges. The second optically synchronised output allows the laser to be used in nonlinear spectroscopy, such as Coherent Anti-Stokes Raman Spectroscopy (CARS), Sum Frequency Generation Spectroscopy (SFG).

REFERENCES

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