

8th International Conference and Exhibition on

LASERS, OPTICS & PHOTONICS

November 15-17, 2017 | Las Vegas, USA

Novel sources and resonators for high-resolution molecular spectroscopy in the mid infrared

Simone Borri

CNR-INO Istituto Nazionale di Ottica, Italy

Molecular precision spectroscopy opens new perspectives on tests of fundamental laws of physics and fundamental constants variation. The mid infrared (IR) is a key region for molecular spectroscopy and the efforts towards the development of versatile, spectrally pure and tunable coherent sources in this region have been constantly growing in the last decade. During the last years, we have made significant efforts in the development of metrological-grade coherent sources. Here, we present our more recent work based on two different approaches, both involving frequency-stabilized mid-IR quantum cascade lasers (QCLs). The first approach is based on crystalline fluoride whispering-gallery-mode resonators. These devices have started to show their full potential for mid-IR photonics in the last two years. They demonstrated record Q-factors ($\sim 10^8$ around $4.5 \mu\text{m}$) and a further increase is expected with the improvement of materials and fabrication techniques. We successfully tested a compact apparatus for high-precision spectroscopy based on mid-IR QCLs locked to fluoride resonators. The low sensitivity of the resonator to environmental noise is one of the strengths of this approach, leading to good stability levels even over long timescales (10 kHz on 1s timescale). The second approach is based on the combination of a mid-IR QCL and a metrological-grade source based on difference frequency generation using an OP-GaP crystal. Here we take advantage of the optical reference delivered from the Italian national laboratory for metrological research (INRIM) through a stable and ever-growing fibre network. This combination allows for mW-level radiation that covers, in principle, the entire molecular fingerprint region, with linewidths at kHz level and with a phase-noise compatible with a 10^{-14} short-term instability.

Biography

Simone Borri has completed his PhD in 2007 from University of Firenze, Italy. He is Researcher at CNR-National Institute of Optics since 2010. His main expertise is development of coherent sources and techniques for high-sensitivity and high-resolution molecular spectroscopy in the mid infrared. During his scientific activity he developed mid-IR and THz sources based on nonlinear frequency generation and worked on trace-gas sensors based on cavity-enhanced absorption spectroscopy, photoacoustic sensing, Doppler-free spectroscopy. He studied the noise properties of quantum cascade lasers and developed locking techniques for linewidth narrowing. He is author of more than 30 publications in peer-reviewed journals.

simone.borri@ino.it

Notes: