The Pan African Conference on Crystallography (PCCR2)
and
The African Light Source Conference (AfLS2)

Contribution ID: **79** Type: **Poster Presentations**

A Widely Tunable 10-µm QCL Locked to a Metrological Mid-IR Reference for Precision Molecular Spectroscopy

Tuesday, 29 January 2019 16:35 (5 minutes)

The quantum cascade lasers (QCL) are popular sources for spectroscopy in the field of mid-infrared because of the wide range of wavelengths they can cover ($3\ \mu m < \lambda < 24\ \mu m$). Several examples of spectroscopic measurements with spectrometers based on QCL, have been demonstrated [2].
We are currently developing a laser spectrometer based on a QCL which emits around 10 µm. The selection of this wavelength for the QCL source is to compare it to our existing ultra-stable CO_2 lasers. We characterized a free-running continuous wave near-room-temperature distributed feedback 10.3 µm QCL. This gave a remarkable result on the frequency noise which is an order of magnitude smaller compared to what was published on the characterization of these types of lasers sources. A full width at half maximum (FWHM) equal to 60 kHz of the beat signal between the free-running QCL and a 1-kHz narrow CO_2
laser was observed after 1 ms of integration time.
Narrowing of the QCL line width has been made by taking a phase-locked QCL on the CO_2 laser which is itself stabilized on a saturated absorption transition of the OsO_4 molecule. The beat spectrum between phase-locked QCL and CO_2 laser recorded with a radio-frequency (RF) spectrum analyzer allowed us to estimate that more of 99% of the beat signal RF power is concentrated in the carried. This allows to conclude that the QCL was copied almost exactly the spectral characteristics of our ultra-stable CO_2 laser (10-Hz line width, accuracy of a few tens of hertz). These results in a record QCL line width of the order of 10 Hz, 3 to 4 orders of magnitude lower than a free-running QCL, and a relative stability at 1 s of about 1 Hz.
The phase-locked QCL was then used to measure the spectra of ammonia (NH_3) and methyltrioxorhenium (MTO) to demonstrate its potential for two main projects of our group: the determination of the Boltzmann constant, kB, by Doppler spectroscopy of ammonia [3] and the first observation of parity violation by Ramsey interferometry of a beam of chiral molecules [4].

References

[1] Kosterev et al.. Applied Physics B, 90(2), 165-176 (2008)
[2] Wysocki et al. Applied Physics B, 92(3), 305-311 (2008)
[3] C. Lemarchand et al. Metrologia 50 623 (2013)
[4] S. K. Tokunaga et al. Molecular Physics 111, Issue 14-15, 2363–2373 (2013)

Primary author: Dr SOW, Papa Lat Tabara (Université Alioune DIOP de Bambey)

Co-authors: Prof. GONCHAROV, Andrey (Institute of Laser Physics of SB RAS, Novosibirsk); Prof. AMY-KLEIN, Ane (Université Paris 13, France); Dr DARQUIÉ, Benoît (Université Paris 13, France); Dr ARGENCE, Bérengère (Université Paris 13, France); Prof. CHARBONNET, Christian (Université Paris 13, France); Prof. DAUSSY, Christophe (Université Paris 13, France); Mr LOPEZ, Olivier (Université Paris 13, France); Dr TOKUNAGA, Sean (Université Paris 13, France); Dr MEJRI, Sinda (Université Paris 13, France)

Presenter: Dr SOW, Papa Lat Tabara (Université Alioune DIOP de Bambey)

Session Classification: AfLS2 Poster Session

Track Classification: AfLS2 track