InP Based QCL for spectroscopy at III-V Lab

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We show the development at III-V lab on QCLs for spectroscopy applications. After explaining the specific approach on metal grating DFB, we present the future development on integrated sources

QCLs are the main semiconductor source for easy to use continuous wave operation in the MIR. The MIR is particularly interesting for the spectroscopy because it presents several windows of atmospheric transmission (with rare and weak absorption lines of H2O and CO2) where we find fundamental ro-vibrational absorption lines of several atmospheric pollutants (NO, N2O, CO, H2CO (formaldehyde) NH3, SO2, etc). These fundamental bands are 2 to 3 orders of magnitude more intense than their harmonics in the near infra-red range (1.0-2.5 µm). Moreover, the majority of the complex organic molecules (more than 5 atoms) which have an interest for defense and safety have also their signatures between 7 and 12 µm.

As for NIR diode, QCL present the possibility of fabricating distributed feedback lasers by using intra-cavity grating for the wavelength selection. There are two main ways of fabricating such device, by buried grating or surface metal gratings. The first is more conventional and is the first one to have led to continuous wave laser [1]. The second is far more easy to use and show similar performances. We have developed such laser at III-V Lab with continuous wave operation at room temperature [2] for the detection of formaldehyde in the framework of ANR project ApolinR []as shown in fig. 1.

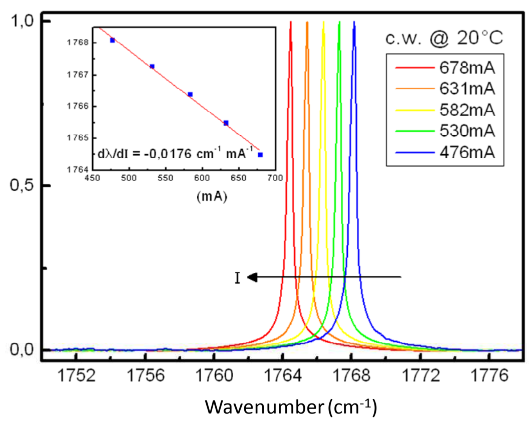

Figure 1 : Example of DFB laser spectra for formaldehyde

These sources enable fine tuning of the laser wavelength (typically a few cm^{-1}). This is sufficient for simple molecules (ie. a few atoms as shown on Fig. 4 with atomic labels) but not for multi-gas applications or complex molecule detection. That is why, in recent developments, widely tunable sources start to be developed.

There are again two ways of obtaining those sources, either by external cavity wavelength and grating or by fabrication of laser arrays.

External cavities based on QCLs are already developed as products [4]. Those products have the advantage of being the first to propose wide tenability. However, they still suffer from complexity, stability, high price.

Another solution consists in DFB arrays. The principle is to fabricate series of N laser, each lasers being at a central wavelength at a few cm^{-1} from its neighbors. Fig 5 shows the result of such a device. Be switching on one after the other each QCL, we obtain a tunable source [5]. The main problem is the use of the output of the laser. A solution is the use of integration.

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