PUBLISHABLE EXECUTIVE SUMMARY (PERIOD 2)

Recent demonstrations of tunable infrared laser sources based on novel nonlinear optical materials have largely renewed the interest for vibrational molecular spectroscopy. Specific absorption features in the mid-infrared (MIR) range of the spectrum are indeed recognized as a powerful and often unique way to provide high sensitivity detection and identification of a large array of molecules. This is particularly relevant in the gas phase in order to avoid preconditioning steps associated with other detection methods (wet chemistry, gas chromatography, mass spectroscopy). Yet, many promising results have remained confined to laboratories for lack of suitable MIR sources, leaving complex Fourier-Transform spectrometers as the only alternative.

To promote direct MIR spectroscopy as a competitive solution for gas analysis, the main technical and scientific objective of the VILLAGE project is the development of a cost-effective widely tunable MIR laser source of high spectral purity. As shown in the Figure 1, this source will combine a 2 µm Thulium (Tm)-doped fibre laser device including a widely tunable Bragg grating stage, a nonlinear frequency converting crystal (Orientation-Patterned Gallium Arsenide, or OP-GaAs) and a high spectral purity optical parametric oscillator (OPO) cavity.

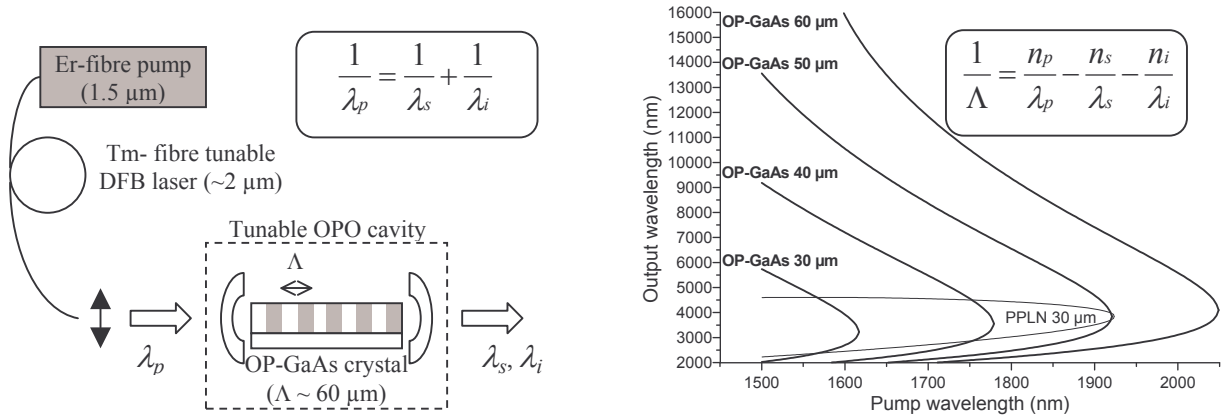

Figure 1 : a) Village source concept (left). b) Typical tuning curves (right).
Insets : key equations linking pump, signal and idler wavelengths, indices and QPM period.

Such a design has the potential for unprecedented performance in terms of both primary specifications and suitability to target multigas analysis of main pollutants generated by and emitted from industrial processes and more specifically of the gases believed to contribute to global warming.

Building on the knowledge and sub-parts obtained during the first year, a simplified version of this tunable MIR source has been recently designed and characterized. Based on difference Frequency Generation (DFG) tunable from 7.6 to 8.2 µm (1200 to 1300 cm^{-1}), it will enable the thorough development, by the end of 2008, of a transportable gas sensing spectroscopic instrument for demonstration through practical tests that the system is capable of analyzing the target gas mixtures at specified concentration levels. Those levels are expected to be in the part per million to trillion range, depending on gas options and laboratory or onsite-based campaigns, according to a validation strategy chosen thanks to a dedicated exploitation-oriented task.

Successful technical achievements of the second year of the project, such as the growth of low loss OP-GaAs samples and the first spectrometric experiment demonstrating methane detection with the DFG setup led to fruitful dissemination, both in publications and communications listed on the VILLAGE project website http://www.neo.no/village/ and through wider channels and events such as OPERA2015 the and the recently accepted participation to the next ICT Exhibition (Lyon, France, 25-27/11/2008).