

Project summary:

VILLAGE is the acronym for **V**ersatile mid-**I**nfrared **L**aser source for **L**ow-cost **A**nalysis of **G**as **E**missions.

To promote direct mid-Infrared (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 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 semiconductor crystal (Orientation-Patterned Gallium Arsenide, or OP-GaAs) and a high spectral purity optical parametric oscillator (OPO) cavity.

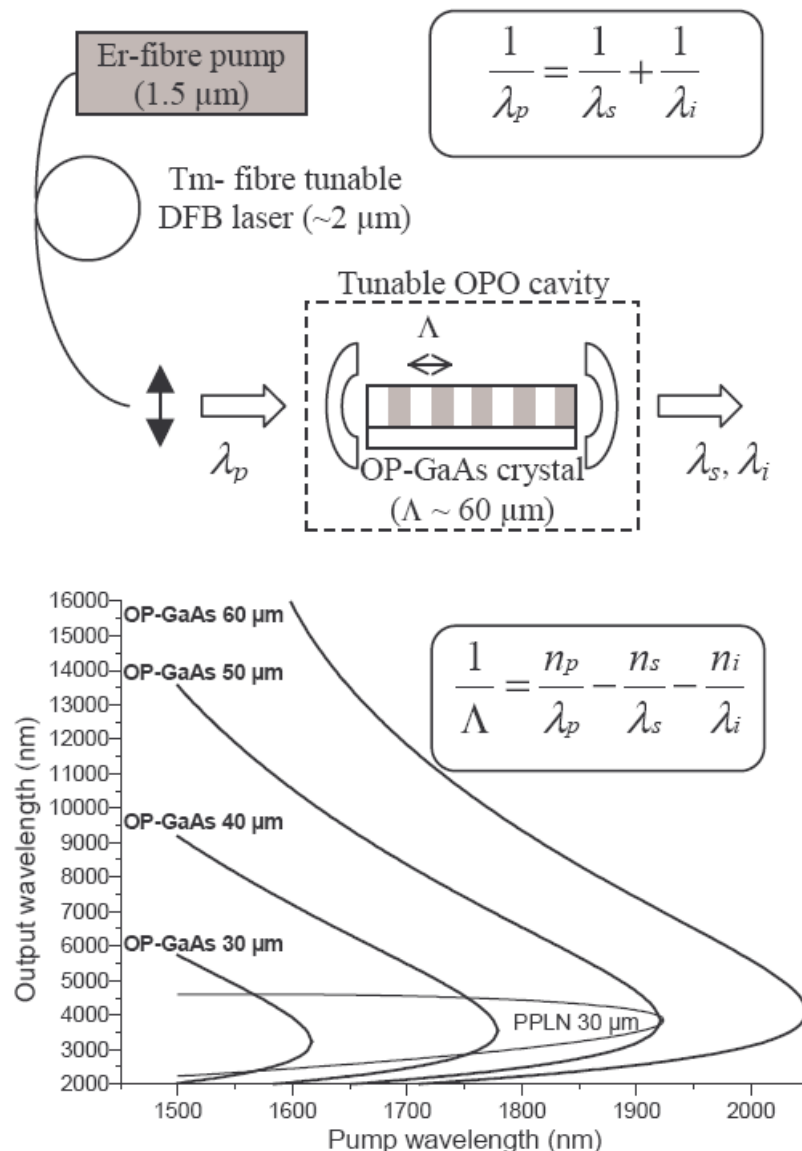


Figure 1 : a) Village source concept (top). b) Typical tuning curves (bottom). Insets : key equations linking pump, signal and idler wavelengths, indices and Quasi-Phase Matching (QPM) period Λ of OP-GaAs crystals and Periodically Poled Lithium Niobate (PPLN).

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.

As reported below, a simplified version of this tunable MIR source has been planned at the end of the first year of the three year project duration. As a second objective and in parallel with further refinements, the MIR source will be integrated into 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.

This approach will enable early promotion of the project results to several other growing instrumentation markets such as food, security and health-related applications. It is also suited to efficient evaluation of VILLAGE scientific and technological choices compared to the state-of-the-art in infrared spectroscopy.

Project progress:

In agreement with the work plan, the first twelve months of the project have enabled the consortium to specify and fabricate, with several characteristics exceeding expectations, all the subparts needed to implement a first version of a MIR tunable source.

This source, based on Difference Frequency Generation, recently gave mid-infrared laser light at wavelengths (centred from 7.6 to 8.2 μm , with a 15 GHz mode-hop free tuning) and power level (up to several hundreds of micro-watts) suitable to spectroscopic measurements of a fundamental absorption line of methane. This experiment will provide useful feedback to design the targeted spectrometers.