The Mid-InfraRed (MIR) domain is concerned by most of the frequencies of molecular vibration and the optical spectroscopy in this range allows the identification and the quantification of chemical compounds corresponding to explosives, pollutants or disease markers. Also, the technological appropriation of this spectral domain represents a major socio-economic challenge because these applications are considered as very current concerns in terms of either security (detection of improvised explosive devices, deliberate food contamination, etc…), or real-time monitoring of atmosphere pollution, or health (speed of analysis procedures, etc…).

These last years, more and more effective detection systems have been developed thanks to the important progress done in the domain of the MIR sources, especially as Quantum Cascade Lasers (QCL), which are offering the possibility to operate at room temperature. Moreover the reached performances by infrared fibres allow now the MIR signal to be transported with a very good quality.

However, there are still lacking efficient elementary components for some MIR applications as for example, to manage the distribution of the light power over different channels. Indeed, the waveguides produced by current technologies based on the use of semiconductor materials generally have coupling losses of the order of 10 dB and propagation losses higher than 1 dB/cm. In other words, the power transported is only about a few percents of the incident power.

The COMI project intends to a technological breakthrough with the fabrication of a waveguide in the midinfrared (3-5 µm), based on an ultra-short pulse laser photo-writing method in a chalcogenide glass, to reach a level of power transported of several tens of per cents.

Our approach consists in inscribing parallel channels of photoinduced refractive index variation to form an array of low diameter cores arranged in a hexagonal lattice (multi-core guide), and next, successive concatenation of transverse section slices are operated. This method, which has been tested in the near infrared, gives excellent results because it allows a simultaneous and independent control of the index contrast amplitude between the cladding and the core, and also the dimensions of the core.

In this project, the optimization of the performance is approached from different angles. Firstly, the influence of the experimental parameters of the inscription on the guiding properties will be established for straight guides. The objective is to determine the combination of these parameters allowing reaching lower propagation losses down to 0.2 dB/cm. Next, more complex components such as curved guides and beam splitter will be considered.

In addition, to optimize the performance of the inscribed waveguides, a work on the vitreous material is carried out. Firstly, the properties of the guides are directly correlated to the amplitude of the index contrast between the photo-inscribed channel and the vitreous matrix but also to its diameter. That's why the composition of the glass will be investigated since it strongly influences these two parameters. Secondly, it is also necessary to reduce the intrinsic losses of propagation in the glass by optimizing the purification process during the synthesis.

Finally, a third task concerns the direct measurement of the characteristics of the variation of the photo-induced index (amplitude and diameter) in the MIR. A method of near-field microscopy will have to be developed. This is an important aspect that will enable us to understand and to control the influence of the experimental parameters of the inscription on the losses.