Abstract

This Thesis focuses on the study, implementation and characterization of chromatic dispersion tailoring employing both optical fiber and photonic integrated waveguides. Chromatic dispersion causes that the different spectral components of an optical pulse travel at different velocities. This effect can be separated into two different fundamental contributions, material dispersion and waveguide dispersion. Chromatic dispersion can be tailored through the design of the structural parameters of the device in order to obtain specific characteristics in the resulting dispersion profile such as low values of dispersion and/or zero dispersion at a desired wavelength, for example. This approach is very useful in dispersion-dependent applications. In this PhD, we investigate chromatic dispersion tailoring in two different transmission mediums, photonic integrated waveguides and optical fiber.

In the first case, two different geometries of Silicon-on-Insulator (SOI) integrated waveguides, strip and slot, are considered. By varying structural parameters such as the cross-section, aspect ratio or fill factor, different chromatic dispersion profiles are obtained. In addition, the influence of the slot location is evaluated. This study is carried out using simulation software in order to obtain the effective refractive index profile as a function of wavelength, which is later differentiated to obtain the final dispersion values. Besides, chromatic dispersion in both waveguide geometries is experimentally measured using an interferometer technique.

In the second case, the chromatic dispersion present in a tapered fiber is studied. A tapered fiber consists of a narrow waist located between two transition regions and it allows the modification of the conventional propagation conditions due to the interference between the modes propagating through the waist. This interference between modes creates a transmission pattern which depends on the waist length and the effective refractive indexes of the modes travelling through the waist. By applying stress to the tapered fiber its interference pattern can be modified. Chromatic dispersion profile of tapered fibers is obtained, tailored and compared with the dispersion profile of conventional single-mode fibers.