Résumé English

The main target of the thesis was the optimization of the nonlinear optical properties of 2D chalcogenide layers for use in applications such as mode-locking and super-resolution.

Firstly, Bi_2Se_3 and Bi_2Te_3 thin films have been deposited by the electron beam deposition technique. Then the thin films have been crystallized in order to obtain significant optical nonlinearities. The thin films have been studied by UV-Vis spectrophotometry, Scanning Electron Microscopy (SEM) and X-Ray Diffraction (XRD) to obtain more information on their optical properties, as well as their morphological properties.

After these investigations the samples have been studied by the Z-scan technique, which allowed a thorough investigation of their nonlinear optical properties. In particular, the third order nonlinear susceptibility has been investigated. Significant nonlinear absorption related to a saturable absorption attribute has been obtained and has been found to be significantly high, compared with other 2D materials already studied in the literature. A detailed comparison with previous published articles is presented in the manuscript.

More specifically, during the thesis, detailed experiments of the third order nonlinear optical susceptibilities have been performed at two different wavelengths (515 nm and 1030 nm) and as a function of several parameters, such as the thickness of the thin films, the annealing temperature and the laser pulse duration. These studies allowed to obtain a precise adjustment of the nonlinear optical response and additionally achieving the maximum optical nonlinearities possible.

A direct laser setup has been also built, allowing to perform direct laser writing on thin layers. Using this setup two different experiments have been carried out. Firstly, diffractive optical elements have been fabricated by nanostructuring the matter with sub-wavelength resolution. Additionally, the possibility to increase the resolution of the direct laser writing by using super-resolution masks exhibiting high third order nonlinearities has been demonstrated.

In conclusion, perspectives of this work and possible applications of the thin films deposited and optimized during the thesis are presented.