Non-linear effects in lasing XUV & soft X-rays and Nanoparticles modified Optics

J. Manuel PERLADO, Pedro VELARDE, Ovidio PEÑA, Antonio RIVERA, Eduardo OLIVA, Manuel COTELO, Agustin GONZALEZ, Alejandro PRADA, Pablo DIAZ NUÑEZ, Pablo MARTINEZ, J. Antonio MORENO, Elisa VAZQUEZ
Instituto Fusion Nuclear, Universidad Politécnica de Madrid, Spain

E-Mail: josemanuel.perlado@upm.es

High Harmonics or XUV laser could be used for probing solid plasmas as refraction index depend strongly on the photon energy. Now, we can calculate the temporal evolution of both the refraction index and the absorption coefficient for high-density plasmas. Increasing the electron density of collisionally pumped plasma-based soft-x-ray lasers offers promising opportunities to deliver ultrashort pulses. However, strong nonlinear effects hinder the propagation of the laser beam and thus the generation of elongated volume of lasing ions to be pumped. Using a particle-in-cell code and a ray-tracing model we demonstrate that optically preformed waveguides allow for addressing those issues through a self-regulation regime between self-focusing and over ionization processes. As a result, guiding intense pulses over several millimeters leads to the implementation of saturated plasma amplifiers.

Modification of optics adding PLD generated nanoparticles of Ag, that are immediately after irradiated by ions, lead to shape modification in orientation and elongation of those particles; that behaviour conducts to enhance different absorption lines depending of those characteristics. The design of multilayer nanoparticles, in which we can make several resonant modes overlap at the same frequency resulting in super absorption, will be presented. The enhanced absorption can be achieved when each mode supported by the nanoparticle absorbs light up to the maximum capacity. In addition, the use of combined femtoseconds lasers and ion beam allow producing Ag nanoparticles, and modifications of their shape and orientation by ion irradiation, arriving to create specific absorption bands to be considered as shielding or filter of optical components.