Laboratoire des Solides Irradiés, UMR 7642

Séminaire

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Post Doc

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Salle 05/1026 - LMS

10h

Self-consistent model of laser-induced optical nonlinearities for modelling of propagation in SiO2 & Raman treatment of femtosecond laser-irradiated vitreous silica.

The first part is dedicated to development of quantum-kinetic models of free-carrier optical nonlinearities for SiO2 and simulation of femtosecond laser pulse propagation. In particular, we consider the "section rules" in Keldysh's photoionisation theory in solids, and collisional absorption model in Kubo-Greenwood terms. Due to accounting interference saddle points, we were able to derive the right formula that correctly describes the multiphoton transitions associated with even and odd number of absorbed photons. Finally, we present preliminary results of simulation of a single-pulse transmission experiment to proof our photoionisation and collisional absorption (beyond Drude's one) models.

The second part is dedicated to experimental measurements and numerical calculations to investigate femtosecond multi-pulse laser-induced densification of vitreous silica and its signature in Raman spectra. We compared the experimental measurements to recently developed molecular dynamics approach considering bond-breaking due to irradiation, together with a dynamical matrix approach with bond polarisability model based on first-principle calculations for the calculation of Raman spectra. We showed evidence of two different densification regimes: a first initial densification followed by a saturation. The sensitivity of the experimental and theoretical Raman spectra to the laser irradiation are in very good qualitative agreement. Moreover, they both support the Sen-Thorpe approach relating specific Raman frequency peaks to inter-tetrahedral Si-O-Si angles. Finally, it is shown that the signature of the laser-induced densification in Raman spectra differs strongly from the signature of densification due to cold compression, thus underlying the role of the thermo-mechanical history of the sample on the signature of density in its Raman spectra.