Title

All-optical probing of intense field ionization inside transparent media

Speaker

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Abstract

While large bandgap optical media used in refractive optical elements and components are transparent to near-infrared (NIR) and optical light pulses at relatively low intensities in the regime where light-matter interaction is linear, at sufficiently high intensities, their interaction with femtosecond (fs) laser pulses turns turns nonlinear owing to multi-photon processes as well as field-assisted processes such as tunnel- and collisional-ionization. Their transparency to NIR and optical fs pulses enables *in situ* studies of nonlinear photoionization even "inside" or beneath the surface of such media. This necessarily requires all-optical measurements schemes and probes both for uncovering the physics of these process and carry out metrology in scenarios close to the damage threshold. We present a brief status report on all-optical transmission measurements which have paved way to this including our own measurements leading to phenomenological models. These continue to lead to a deeper understanding of dynamical processes. The ensuing dynamics can be categorized into two timescales: the first is a long pulse regime, for temporal duration τ_p, $\tau_p > 100$ fs, where laser driven electrons in these media gain sufficient kinetic energies by mechanisms such as inverse bremsstrahlung leading to electron avalanches. In the short pulse regime, $\tau_p < 100$ fs, these electrons are excited to the conduction band by multiphoton absorption. Not only do these studies provide facile means to study intriguing nonlinear photoionization processes, but they also probe these systems in a regime of intensities and pulse widths where micro- and nano-structuring as well as processing of materials by fs pulses are often realized. Further, these methods compliment research on coherent processes such as the generation of high-order harmonics and attosecond pulses in condensed phase media.