56
High-Order Harmonic Generation and Plasmonics

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Abstract Attosecond pulses allow for imaging of very fast processes, like electron dynamics. Stockman et al. suggested to use these pulses in connection with a Photoemission electron microscope (PEEM) to study the ultrafast dynamics of plasmons (Stockman et al. Nat Photonics 1:539–544, 2007). For efficient plasmon studies, the repetition rate of the attosecond pulses used needs to be higher than a few kHz (Mikkelsen et al. Rev Sci Instrum 80:123703, 2009). Attosecond pulses are produced in a process called high-order harmonic generation (HHG) (Paul et al. Science 292(5522):1689–1692, 2001; Ferray et al. J Phys B At Mol Opt Phys 21:L31–L35, 1988). In HHG, a strong laser field allows an electron to tunnel out, get accelerated and recombine with a high kinetic energy resulting in extreme ultraviolet attosecond pulses. The large intensity needed to drive the process normally limits the repetition rate of the laser to a few kHz. Using a tight focusing scheme (Heyl et al. Phys Rev Lett 107:033903, 2011; Vernaleken et al. Opt Lett 36:3428–3430, 2011), we, however, generate harmonics at a repetition rate of 200 kHz, both with a commercial turn-key laser and with an advanced laser system. Suitable nanostructures for a strong field enhancement are produced in-house and the field enhancement is studied with PEEM in a non-time resolved manner. With high-order harmonics produced at a high repetition rate, we hope to be able to follow also the ultrafast dynamics of plasmons in these structures (Mårsell et al. Ann der Phys 525:162–170, 2013).

Keywords High-order harmonic generation • Nanostructures • Plasmonics

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