THESE LIDYL

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Spatio-temporal control of high harmonic generation in semiconductors for attosecond pulse emission

High order laser harmonic generation in condensed media has been an emerging field since its first observation in 2011. The strong dependency of the harmonics on the crystal band structure and laser parameters makes them an excellent observable of the fundamental mechanisms during strong field processes. Moreover, the compact configuration of this all solid-state source, combined with the possibility for structuring the generation medium, makes it a promising source of extreme ultraviolet radiation for e.g. spectroscopy or imaging applications. In this thesis three different aspects of high harmonic generation in crystals are investigated, all related to the spatio-temporal structure of the harmonics. First, doping, which induces changes of the band structure, and its effect on the emission process. The two example systems for this are chromium doped magnesium oxide and gallium implanted silicon, for which the doping leads to an enhancement of the harmonic yield. After, we show that by using a coherent diffraction imaging technique, it is possible to image silicon nanostructures solely based on the harmonics emitted by the structure itself. Because surface nanostructuring is emerging as a way of inducing complex properties directly into the harmonic beam, such as an orbital angular momentum, this opens up the possibility of in-situ characterization of these structures. Finally, the concept of polarization gating used in gases is adapted to solids by using the strong anisotropic harmonic response. This is used to temporally shape the emission and push towards isolated attosecond pulse generation.