Light-induced Currents in Dielectrics and Wide Bandgap Semiconductors: Quantum-kinetic Approach

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We propose a theoretical description for electric currents in dielectrics and wide-gap semiconductors induced by high-intensity ultrashort laser pulses. In order to account for nonlinear changes of dielectric screening, the semiconductor Bloch equations have been solved self-consistently with equations for the electric field inside the medium. We solve these equations numerically for a one-dimensional lattice and provide a detailed analysis of the physically important quantities: the population distribution of charge carriers, current density, and macroscopic polarization. We also discuss the limits of applicability of this theory and estimate the validity of a simpler model with the constant dielectric screening. The comparison of our results with experimental data for fused silica and GaN has shown a good agreement.