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Development of an Extreme Ultraviolet Light source and Beamline for Femtosecond Nonlinear Spectroscopy MUHAMMAD FAREED, RICHARD THURSTON, MATTHEW BRISTER, KIRK LARSEN, WAEL ISKANDAR, THORSTEN WEBER, DANIEL SLAUGHTER, Chemical Sciences Division, Lawrence Berkeley National Laboratory, Berkeley — Recently, we have demonstrated that the laser-ablation technique is an effective method to produce intense and broadband high-order harmonic (HH) laser light with linear and rotated polarization (Singh, M. *et al.*, APL **115**, (2019) 231105.). These HH laser pulses are predestined to produce intense attosecond pulse trains or investigate ultrafast nonlinear dynamics in gases or materials with a single harmonic, having narrower spectral width (femtosecond pulse). We are developing an ultrafast light source with an expected energy of ~5 J per pulse per harmonic in the spectral region from 4.7 eV to 26 eV, sub-ten fs pulse length, tunable intensity and energy, coherent, and stable at high repetition rates (>1 kHz), employing high-order harmonic generation (HHG) of intense laser light from laser-ablated plumes (LAP). HHG from LAP has the advantage to produce extreme ultraviolet (XUV) photons (up to ~156 eV) with near-infrared driving fields. This light source will be used to study the 3rd order nonlinear response of excited molecules by ultrafast transient polarization spectroscopy. We report recent developments of experimental tools to split, delay and focus two femtosecond XUV pulses and one or more near infrared pulses in a gas cell, and to analyze the polarization and spectrum of the XUV light generated by four-wave mixing.

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