M. Hofstetter[1], A. Aquila[3], E. Gouliemakis[2], M. Schultze[2], M. Uiberacker[1], E. Gullikson[3], D.T. Attwood[3], F. Krausz[1,2] and U. Kleineberg[1]

[1]Ludwig Maximilians Universität Muenchen, Fakultaet fuer Physik, D-85748 Garching
[2]Max Planck Institut fuer Quantenoptik, D-85748 Garching, Germany
[3]Center for X-Ray Optics, Lawrence Berkeley National Laboratory, Berkeley, CA

Design, Characterization and Applications of Broadband MoSi- Multilayer Mirror for Attosecond XUV Pulses

Multilayer-coated XUV mirrors in combination with ultrathin metal transmission filters are known to be very suitable for spectral filtering and guiding of single attosecond XUV pulses from High Harmonic Generation (HHG) sources which occur in the near-cutoff region of the High Harmonic spectrum excited by few-cycle femtosecond laser in rare gases.
We report on the design of periodic as well as aperiodic Mo/Si multilayer with large spectral bandwidth (15-30 eV) centered at ~ 85 eV which have been theoretically developed and optimized by a needle algorithm code (OPTILAYER) for optimum pulse response and dispersion characteristics, including the quantitative control of the spectral chirp of the pulse upon reflection.
The different multilayer stacks have been fabricated by advanced Dual Ion Beam Deposition (DIBD) where the layer thicknesses (sputtering rates) are controlled by spectroscopic insitu-ellipsometry. Ex-situ characterization of the normal incidence XUV reflectivity of the multilayer coatings have been performed by Synchrotron Radiation measurements at the Advanced Light Source.
Recent results published have demonstrated the filtering of single 170 attosecond pulses, which were recorded in XUV pump/IR probe electron streaking experiments, using a 100 nm Zirconium transmission filter and an aperiodic MoSi-multilayer in the 80-95 eV photon energy range*.
By further optimizing the reflectivity bandwidth as well as the dispersion of the multilayer designs, even shorter pulse durations towards the (sub) 100 attosecond range are expected.
Finally, the extension of attosecond multilayer mirror technology towards higher photon energies exceeding 100 eV using different multilayer materials (La and B4C) and even smaller layer thicknesses in the 1-3 nm range will be discussed. The successful implementation will possibly enable new time-resolved photoemission experiments on solid surfaces with sub 100 asec time resolution in the near future.

*New Journal of Physics **9** (2007) 243