University of Central Florida

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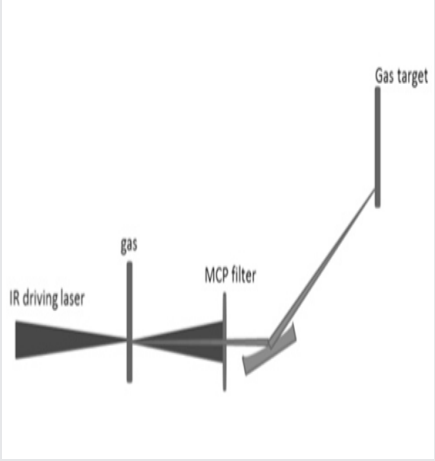
High-Power Damage-Resistant XUV Bandpass Filter

Due to its design geometry, an uncoated custom designed microchannel plate (MCP) can act as an extreme-ultraviolet (XUV) and soft X-ray (SXR) filter blocking infrared pump source light that would otherwise interfere with and mask the ultrashort & attosecond pulses of High Harmonic Generation (HHG) based systems.



Background

Since the first demonstration of isolated attosecond pulses from HHG, the evolution of time-resolved research of ultrafast phenomena into the attosecond domain has had a major impact on our understanding of electronic processes in atoms, molecules, and condensed matter. Usually, the energy conversion efficiency of HHG is only ~10-7, and the residual pump laser propagates coaxially with the attosecond XUV pulses, making it essential to block the residual pump laser. To solve this dilemma, a new technology employs an MCP as a bandpass XUV filter, which allows the XUV beam to pass through with a high transmission while reflecting the infrared (IR) or near-infrared (NIR) pump beam.

Advantages

UCF researchers have developed an advanced optical filtering method with a very high damage threshold to separate XUV wavelengths greater than 200 eV from the pump laser pulse often containing tens or hundreds of millijoules (mJ) of energy per pulse. Compared to conventional methods, this technique is easier to implement and can be used for HHG ultra-broadband XUV generation, isolated attosecond pulse generation, and high flux attosecond SXR generation based on HHG. With easy installation and a high damage threshold, the filter offers significant advantages over fragile thin metal foil filters, which have been unable to withstand high-intensity pump light and vibration. This new filter can greatly improve commercial HHG-based XUV sources for applications such as medical diagnostics, XUV lithography, and radiography of shielded structures by significantly improving the XUV pulse to pump signal ratio.

Technical Details

HHG generated pulses in the XUV and SXR spectral ranges, from several eV to keV energies, pass through the MCP filter while IR and NIR wavelengths are reflected, allowing for rejection of up to hundreds of mJ's of pump light, an amount unmatched by any other technique. The filtering works analogous to that of a microwave door, where the wavelengths smaller than the dimensions of the periodic structure can propagate through, while those larger become evanescent and reflect off the structure. The MCP is fabricated from a resistive material, such as glass, with a dense array of parallel microchannels (typically 5-25 micrometers in diameter) leading from one surface to the other. Since this XUV filter blocks infrared pump source light, it is especially useful for next-generation mid-infrared pump lasers, the future for generating even shorter attosecond pulses.

Benefits

- Transmits XUV beams in a broad energy range
- High damage threshold
- Endures IR pump energy up to hundreds of mJ
- Low-cost and simple to implement

Applications

- Medical diagnostics
- XUV lithography
- Radiography

Tech Fields

Optics & Lasers

Keywords

high-harmonic generation, HHG, extreme ultraviolet, XUV, soft x-ray, SXR, MCP, optical filter, XUV lithography, radiography

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