Possibility of high-Z plasma water window sources

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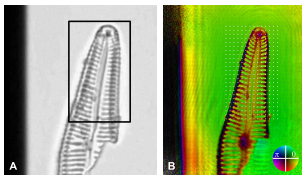
Abstract

We demonstrate EUV and soft x-ray sources in the 2 to 7 nm spectral region related to the beyond EUV (BEUV) question at 6.x nm and a water window source based on laser-produced high-Z plasmas. Resonance emission from multiply charged ions merges to produce intense unresolved transition arrays (UTAs), extending below the carbon K edge (4.37 nm). We will discuss the progress and Z-scaling of UTA emission spectra to achieve lab-scale table-top, efficient, high-brightness high-Z plasma EUV-soft x-ray sources with the soft x-ray microscope for in vivo bio-imaging applications.

Summary

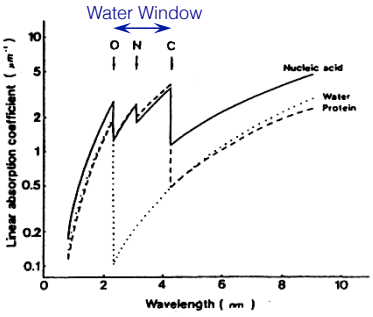
We have demonstrated high-efficiency emission in the water window spectral region based on laser-produced **high-Z plasmas** and have proposed methods to increase it still further. Resonance emission from multiply charged ions merges to produce intense UTA, extending to wavelengths below the carbon K edge.

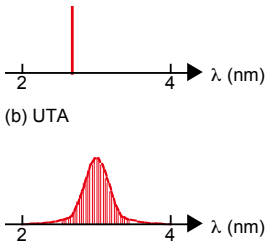
Background

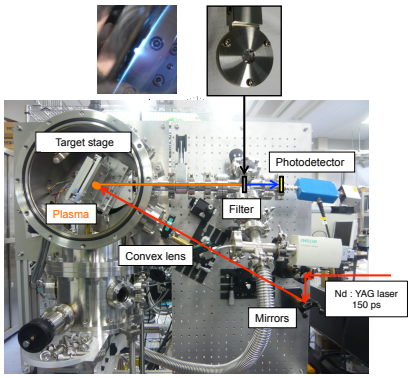


(A) Optical micrograph of a fossil diatom sample. The area scanned by the x-ray beam is marked by a black frame.
(B) Complex-valued ptychographic reconstruction of the object transmission function from the same diatom sample as shown in subfigure A.

K. Giewekemeyer *et al.*, Opt. Exp. **19**, 1037 (2011).



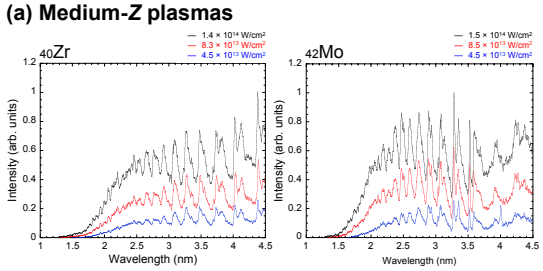




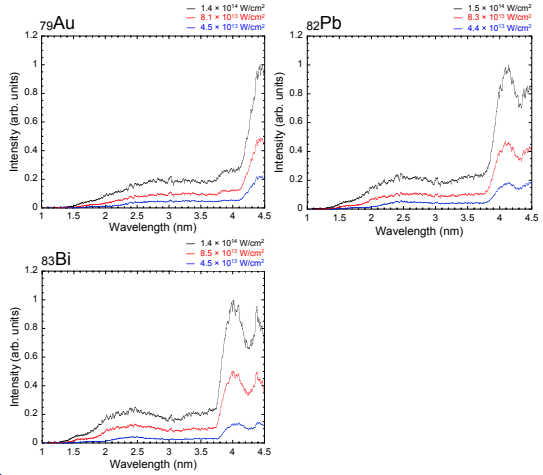
Experimental results

UTA spectra in water window

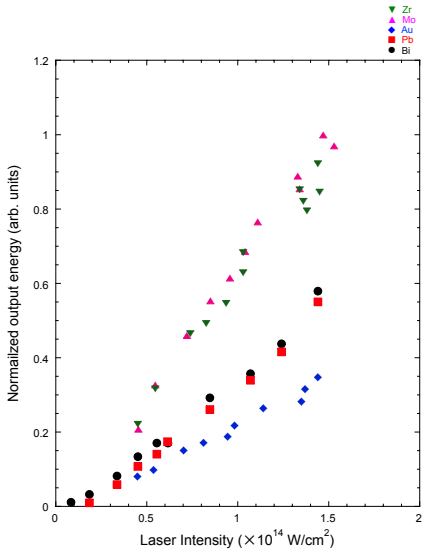
(a) Medium-Z plasmas



(b) High-Z plasmas

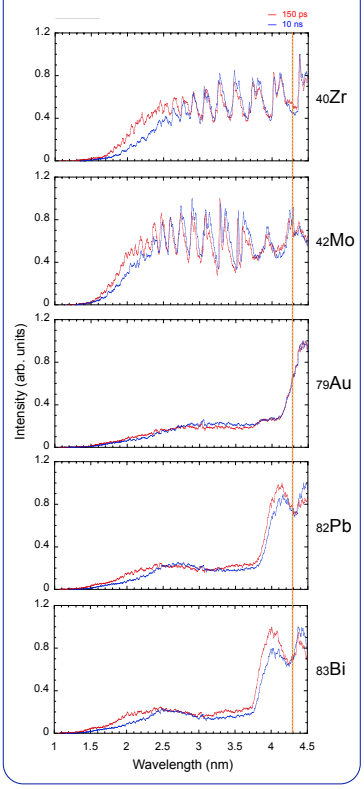


Water window output (2.3 ~ 4.4 nm)



- Similar behavior in laser intensity dependences at 150 ps and 10 ns.
- Outputs in 2.3-4.4 nm of Zr and Mo were larger than that of Au, Pb, and Bi.
- Strong UTA emission around 4 nm in Bi source.
- Many peaks were appeard in Mo and Zr.
- Absorption structure around 4.4 nm due to carbon element in multi-charged-state ion plasmas.

Absorption by carbon



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"Water window" sources: Selection based on the interplay of spectral properties and multilayer reflection bandwidth

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