PiAI Seminar Series: Physics informed AI in Plasma Science
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Web Seminar

Computational methods to construct an accurate and complete atomic model of complex multiple charged ion of heavy elements

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We investigate extreme-ultraviolet (EUV) light emission from multiple charged ions of Sn for the light source for microlithography in the semiconductor technolgy. The Sn plasmas show strong emission at the wavelength of 13.5 nm through a large number of 4d-4f and 4p-4d transitions, which refer to UTA (Unresolved Transition Array), arise from near 10 times ionized ions. To predict that emission spectrum from Sn plasmas, we develop the atomic model of Sn ions taking a large set of multiple excited states [1], which have considerable population in the plasma and decide the ionization balance and the intensity and spectral width of the emission. To develop the model, firstly we choose a set of atomic states using a computer algorithm [2], secondly, we calculate energy levels and radiative rates, that correspond to the atomic states, using the HULLAC code [3], thirdly we calculate the mean charge and radiative power loss from the plasma using the collisional radiative model. Then the model is determined after investigating the convergence of the result with respect to the size of the model. Calculated spectrum using the model has shown to agree well with experiment, by taking the effect of configuration interaction (CI) to the atomic wavefunction into account. Possible application of the present method to heavier elements for further application will be discussed.

(References)

[1] A. Sasaki, et al., J. Appl. Phys. 107, 113303 (2010).

[2] A. Sasaki, HEDP 9, 325 (2003).

[3] A. Bar-Shalom, et al. JQSRT, 71, 169 (2001).