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Atomic data of low-charged Sn ions for lithography applications[1]

JAMES COLGAN, A. J. NEUKIRCH, D. P. KILCREASE, J. ABDALLAH, M. E. SHERRILL, C. J. FONTES, P. HAKEL, Los Alamos National Laboratory — The intense emission of tin plasma in the 13.5 nm wavelength band has long been recognized for its potential as a powerful EUV source with important lithography applications. The efforts to predict the plasma properties of Sn that produce these intense emission features are complicated by the complex atomic structure of the Sn ions in question. We have examined the atomic structure and opacity of Sn at low temperatures (< 50 eV), where these ions dominate the absorption features. In recent studies, we found that the use of intermediate-coupling, as compared to full configuration-interaction, is not adequate to obtain accurate line positions of the important bound-bound transitions in Sn. One requires full configuration-interaction to properly describe the strong mixing between the various n=4 sub-shells that give rise to the Δn=0 transitions that dominate the opacity spectrum at low temperatures. Since calculations that include full configuration-interaction for large numbers of configurations quickly become computationally prohibitive, we have explored hybrid calculations. Our calculations are performed using the Los Alamos suite of atomic physics codes. Preliminary results indicate that our models find good agreement with measurements from laser-produced plasmas.

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