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WebEx Meeing
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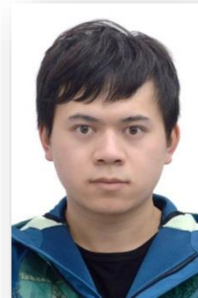
Experimental study on spectroscopy of laser-produced plasma for laboratory astrophysics and soft X-ray lithography application



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Abstract

Spectroscopy technology is widely used both in basic science and industrial applications. In this research, first part we designed an experiment which is aiming at observing the Zeeman effect in the spectrum, a fundamental physical phenomenon but has not been successfully observed in the high field (>10^3 T) magnetized plasma experiment. The second part we apply the spectroscopy method to measure the EUV-induce hydrogen plasma parameters, which is important for the soft X-ray or EUV lithography applications.

According to the Zeeman experimental design we use the Magnetohydrodynamics (MHD) modeling to examine the plasma parameters and the magnetic field strength. The modeling shows that using the advanced low-density foam target fabrication technology and GEKKO XII laser system it is possible to generate a 10 kT strong field in 100 eV electron temperature and 10^{21} cm-3 electron density plasma. These physical conditions make a 96 eV Si XII line's Zeeman splitting measurable under the current spectroscopy technology [1][2].

For the purpose of applying the Sn cleaning effect in the EUV-induce hydrogen plasma, it is necessary to determine the plasma parameters in the EUV photoionized hydrogen ones. Using the spectroscopy technology, we calculate the plasma temperature and density by the Balmer line profiles. With cross-section estimation confirms the measured density and the first 2D EUV-induce hydrogen plasma emission images confirm the temperature. 1eV / 2×10^{13}cm^{-3} gives a hydrogen radical population density of 3.7×10^{12}cm^{-3}. The Sn cleaning effect is examined by this value. This technology has potential application which can improve the working efficiency of EUV lithography (EUVL) [3].

The presentation shows the details of this research which both contribute to the HEDP and EUVL.

References
[1] C. Liu et al., High Energy Density Phys, 33, 100710 (2019).
[2] KFF. Law et al., Phys. Rev. E 102 (3), 033202 (2020).
[3] J. Beckers et al., Appl. Sci. 9(14), 2887(2019).